PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU 773

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing (day/month/year) 03 September 2001 (03.09.01)	
International application No. PCT/US00/17476	**Applicant's or agent's file reference** RCA90195
International filing date (day/month/year) 26 June 2000 (26.06.00)	**Priority date** (day/month/year) 05 October 1999 (05.10.99)
Applicant RICHARDSON, John, William et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

02 May 2001 (02.05.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Antonia MULLER
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992) US0017476

PATENT COOPERATION TREATY

EXPRESS EV025963040 US

From the INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

-Fax nr: [redacted]-734-9700

-11 pages-

PCT

To:

FYI

TRIPOLI, Joseph S.
THOMSON MULTIMEDIA LICENSING INC.
P.O. Box 5312
2 Independence Way
Princeton, New Jersey 08540
ETATS-UNIS D'AMERIQUE

Confirmation FAX-Bestätigung
RECEIVED
FEB 11 2002
683

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	28.01.2002
Applicant's or agent's file reference: RCA 90195	IMPORTANT NOTIFICATION
International application No.: PCT/US00/17476	International filing date *(day/month/year)*: 26/06/2000
	Priority date *(day/month/year)*: 05/10/1999
Applicant: THOMPSON LICENSING S.A. et al.	

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Barrio Baranano, A Tel.+49 89 2399-8621

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
RCA 90195		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US00/17476	26/06/2000	05/10/1999
International Patent Classification (IPC) or national classification and IPC		
H04L12/64		
Applicant		
THOMPSON LICENSING S.A. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☐ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
02/05/2001	28.01.2002
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Hamer, J Telephone No. +49 89 2399 8827

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US00/17476

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1,2,4-28	as originally filed			
3,3a	as received on	07/01/2002	with letter of	07/01/2002

Claims, No.:

1-20	as received on	07/01/2002	with letter of	07/01/2002

Drawings, sheets:

1/22-22/22	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application.

   ☒ claims Nos. 1-20.

because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

   ☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 1,10,19 are so unclear that no meaningful opinion could be formed (*specify*):
   see separate sheet

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the standard.

   ☐ the computer readable form has not been furnished or does not comply with the standard.

III- No Opinion

1. The subject-matter of claim 1 is directed towards a system for providing a telephone service in a digital subscriber loop environment. According to the claim, the system contains a device for converting an analogue signal into an ATM compatible format. Remote from the device is a modem which can receive the ATM compatible digitized signals. The claim also specifies a signal digitizer which can receive an analogue signal from the telephone.

   In the claim, it is not clear where in the system the signal digitizer is, i.e. whether it is at the customer premises or co-located with the modem or somewhere else. It is also not clear what format the output of the signal digitizer has and what happens to the digitized signals from either source. Furthermore, it is not clear how the two modes of operation are chosen or switched between.

   Although the claim is concerned with providing a telephone service, the signals either end in the modem or in a digitiser in the claim. There is no indication as to what happens to them next.

   Thus, claim 1 is not clear and does not contain all the features necessary for the implementation of the invention, contrary to the requirements of Article 6 and Rule 6.3(b) PCT. As a result, no opinion can be given regarding novelty and inventive step.

2. Independent method claim 10 and independent apparatus claim 19 essentially repeat the subject-matter of claim 1 and suffer from the same defects. Thus for the same reasons as given above, no opinion can be given regarding these claims.

3. Dependent claims 2 to 9, 11 to 18 and 20 are not appended to an independent claim which meets the requirements of the PCT. They do not appear to contain subject-matter which would rectify the above problems.

4. The following deficiencies are found in the application:

a) The independent claims do not meet the requirements of Rule 6.3(b) PCT in that they are not divided into the two-part form.

b) The documents cited in the International Search Report should be referenced and briefly discussed in the description, Rule 5.1(a)(ii), PCT.

c) The description should have been modified to bring it into agreement with the modified independent claims, Rule 5.1(a)(iii), PCT.

proposed a CopperComplete™ DSL architecture, shown for example, in Fig. 2.

The system architecture provided by CopperComplete™ DSL uses a voice gateway 21 behind the ATM switch 22. The voice gateway 21 is an additional piece of equipment that converts the packetized voice traffic to voice signals acceptable to the PSTN (Public Switched Telephone Network) via a Class 5 switch 23. The voice gateway 21 converts the incoming ATM Adaptation Layer 2 (AAL2) cells to time division multiplexed voice signals and sends it to the Class 5 switch 23 using multiple T1 trunks 24. This interface is, for example, GR-303 interface, the same as used by digital loop carriers (DLC), as described before in connection with Fig. 1.

It is believed the voice path used in the Coppercom architectures is a permanent virtual circuit (PVC) that is configured during the provisioning of the CPE device, not in real time. This PVC carries all voice traffic as well as signaling traffic. The packet architecture used is ATM Adaptation Layer 2 (AAL2) for ATM encapsulation.

AAL2 has the ability to allow multiple connections multiplexed on one virtual circuit (VC). The multiplexing of multiple streams of data is done at the ATM Adaptation Layer. ATM adaptation only takes place at the endpoints of an ATM network. Cells in an ATM network are routed or switched based upon their virtual path/virtual channel (VP/VC) identifier. In the case of a permanent virtual circuit (PVC), as in the case of the Coppercom architecture, the cells are switched to the same permanent destination previously established at the time of the CPE provisioning.

The Coppercom architecture does not use the ATM network to setup and teardown the voice connections, but instead uses the voice gateway. It is, therefore, not possible to take advantage of the ATM network for switching of individual voice calls. This is because, as explained previously, in the Coppercom architecture, multiple voice calls are multiplexed along with signaling data onto a single ATM virtual circuit. The contents of the ATM cell stream are transparent to the ATM network. The ATM network only examines the header to ensure they are sent to the correct destination. The call assignment or switching in this architecture is independent of the ATM network. The call assignment cannot be determined until the signaling and voice data is de-multiplexed at the voice gateway.

In addition, WO 99/14929 describes an apparatus for providing a telephone service over a packet network. However, unlike the present invention, the apparatus does not mention the use of using ATM data packets for routing a voice call in a DSL environment. In addition, that apparatus does not appear to contemplate alternate routing when a failure mode is encountered.

SUMMARY OF INVENTION

Present inventors recognize that there are several drawbacks to prior DSL architectures. By using ATM AAL2 to carry voice, these architectures add significant cost and complexity to the end user equipment in terms of compression (when applicable), silence

CLAIMS

1. A system (Fig. 21) for providing a telephone service in a digital subscriber loop environment, comprising:

a customer interfacing unit (CPE Unit) for receiving an analog signal from a telephone and converting the analog signal into a digital signal in a first format, the first format being an ATM-compatible format;

a modem (SDLAM) residing remotely from the customer interfacing unit for receiving the digital signal in a first format;

a signal digitizer (2105) capable of receiving the analog signal from the telephone;

the system, in a first mode of operation, coupling the digital signal in the first format to the modem; and in a second mode of operation, coupling the analog signal from the telephone to the digitizer.

2. The system of claim 1 wherein the first mode of operation is a normal mode of operation.

3. The system of claim 2 wherein the second mode of operation is a failure mode of operation.

3. The system of claim 1 wherein the digital signal in the first format is coupled to the modem via a digital subscriber loop.

4. The system of claim 1 wherein the analog signal from the telephone is coupled to the digitizer via telephone wires.

5. The system of claim 3 wherein the analog signal from the telephone is coupled to the digitizer via a telephone wires.

6. The system of claim 1 wherein the modem further converts the received digital signal in the first format to a digital signal in a second format.

7. The system of claim 6 wherein the digitizer further converts the received analog signal from the telephone to a digital signal in a third format.

8. The system of claim 7 wherein the second format is the same as the third format.

10. A method for providing a telephone service using a digital subscriber loop, comprising the steps of:

receiving an analog signal from a telephone and converting the analog signal into a digital signal in an ATM compatible format;

coupling the digital signal in the format to a modem residing remotely in a first mode of operation; and

coupling the analog signal from the telephone instead to a digitizer residing remotely, in a second mode of operation.

11. The method of claim 10 wherein the telephone service is a POTS.

12. The method of claim 10 wherein the first coupling step is done via a digital subscriber loop.

13. The method of claim 10 wherein the second coupling step is done via a digital subscriber loop.

14. The method of claim 12 wherein the second coupling step is done via a digital subscriber loop.

15. The method of claim 10 further comprising the step of converting the received digital signal in the first format to a digital signal in a second format at the modem.

16. The method of claim 10 further comprising the step of converting the received analog signal from the telephone into a digital signal in a third format at the digitizer.

17. The method of claim 16 wherein the second format is the same as the third format.

18. The method of claim 10 wherein the second mode of operation is a power failure mode of operation.

19. An apparatus for providing a DSL voice service, comprising:

an interface for coupling to a telephone on a customer site;

a processor for converting an analog signal from the telephone to a digital signal in an ATM compatible format; and

a switch, in a first mode of operation, operative to couple the digital signal to a modem on a remote location; and in a second mode of operation, for coupling the analog signal from the telephone to a digitizer on a remote location.

20. The apparatus of claim 19 wherein the second mode of operation is a failure mode.

INTERNATIONAL SEARCH REPORT

Int [redacted] Application No
PCT/[redacted]00/17476

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/64 H04Q11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 99 14929 A (MEDIATRIX PERIPHERALS INC ;MENARD FRANCOIS (CA)) 25 March 1999 (1999-03-25) page 6, line 20 -page 7, line 12; figure 1 page 11, line 15 -page 12, line 5	1,2,4,6, 10,11, 15,19 3,7-9, 12, 16-18,20
Y	WO 97 38511 A (AT & T CORP) 16 October 1997 (1997-10-16) page 21, column 21 -page 22, column 5; figures 1,4	9,18,20
Y	WO 97 46073 A (ERICSSON TELEFON AB L M ;HANSSON ALLAN (SE); TOENNBY INGMAR (SE)) 11 December 1997 (1997-12-11) figure 7 claims 30,31	3,7,8, 12,16,17

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 October 2000	02/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gregori, S

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

[redacted]

Int[redacted] Application No
PCT/[redacted]00/17476

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 844 802 A (PLESSEY TELECOMM) 27 May 1998 (1998-05-27) column 3, line 39 –column 4, line 48	1-20

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int[redacted] Application No
PCT/[redacted]00/17476

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9914929 A	25-03-1999	AU 9149098 A	05-04-1999
		EP 1016260 A	05-07-2000
WO 9738511 A	16-10-1997	CA 2250789 A	16-10-1997
		EP 0894386 A	03-02-1999
WO 9746073 A	11-12-1997	SE 506775 C	09-02-1998
		SE 511236 C	30-08-1999
		AU 3113697 A	05-01-1998
		AU 3113797 A	05-01-1998
		AU 3198597 A	05-01-1998
		AU 721188 B	22-06-2000
		AU 3198697 A	05-01-1998
		CN 1221530 A	30-06-1999
		CN 1221533 A	30-06-1999
		CN 1221531 A	30-06-1999
		CN 1221534 A	30-06-1999
		EP 0898837 A	03-03-1999
		EP 0898833 A	03-03-1999
		EP 0903031 A	24-03-1999
		EP 0898838 A	03-03-1999
		SE 9602212 A	05-12-1997
		SE 9603932 A	29-04-1998
		WO 9747118 A	11-12-1997
		WO 9747127 A	11-12-1997
		WO 9747119 A	11-12-1997
		AU 5236698 A	22-06-1998
		BR 9713451 A	28-03-2000
		CN 1238881 A	15-12-1999
		EP 0948860 A	13-10-1999
		SE 9604409 A	30-05-1998
		WO 9824224 A	04-06-1998
EP 0844802 A	27-05-1998	CN 1193227 A	16-09-1998
		GB 2319701 A,B	27-05-1998

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
RCA90195		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 00/ 17476	26/06/2000	05/10/1999
Applicant		
THOMPSON LICENSING S.A.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 21

   [ ] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [X] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/17476

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/64 H04Q11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 99 14929 A (MEDIATRIX PERIPHERALS INC ;MENARD FRANCOIS (CA)) 25 March 1999 (1999-03-25) page 6, line 20 -page 7, line 12; figure 1 page 11, line 15 -page 12, line 5	1,2,4,6, 10,11, 15,19 3,7-9, 12, 16-18,20
Y	WO 97 38511 A (AT & T CORP) 16 October 1997 (1997-10-16) page 21, column 21 -page 22, column 5; figures 1,4	9,18,20
Y	WO 97 46073 A (ERICSSON TELEFON AB L M ;HANSSON ALLAN (SE); TOENNBY INGMAR (SE)) 11 December 1997 (1997-12-11) figure 7 claims 30,31	3,7,8, 12,16,17

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 October 2000	02/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gregori, S

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/17476

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 844 802 A (PLESSEY TELECOMM) 27 May 1998 (1998-05-27) column 3, line 39 -column 4, line 48	1-20

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PC[redacted]/US 00/17476

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9914929 A	25-03-1999	AU 9149098 A	05-04-1999
		EP 1016260 A	05-07-2000
WO 9738511 A	16-10-1997	CA 2250789 A	16-10-1997
		EP 0894386 A	03-02-1999
WO 9746073 A	11-12-1997	SE 506775 C	09-02-1998
		SE 511236 C	30-08-1999
		AU 3113697 A	05-01-1998
		AU 3113797 A	05-01-1998
		AU 3198597 A	05-01-1998
		AU 721188 B	22-06-2000
		AU 3198697 A	05-01-1998
		CN 1221530 A	30-06-1999
		CN 1221533 A	30-06-1999
		CN 1221531 A	30-06-1999
		CN 1221534 A	30-06-1999
		EP 0898837 A	03-03-1999
		EP 0898833 A	03-03-1999
		EP 0903031 A	24-03-1999
		EP 0898838 A	03-03-1999
		SE 9602212 A	05-12-1997
		SE 9603932 A	29-04-1998
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PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT/US 00/17476
International Application No.

26 JUN 2000 (26.06.00)
International Filing Date

PCT INTERNATIONAL APPLICATION
Name of Receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* RCA90195

Box No. I TITLE OF INVENTION

SYSTEM AND METHOD FOR PROVIDING POTS SERVICES IN DSL ENVIRONMENT IN EVENT OF FAILURES

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

THOMSON LICENSING S.A.
46, quai Alphonse Le Gallo
92648 Boulogne Cedex - France

☐ This person is also inventor.

Telephone No.
+33141865000

Facsimile No.
+33141865633

Teleprinter No.

State *(that is, country)* of nationality:
FR

State *(that is, country)* of residence:
FR

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

RICHARDSON, John William
2026 North East Bay Drive Apt. B
Greenfield, Indiana 46140
United States of America

This person is:

☐ applicant only
☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:
US

State *(that is, country)* of residence:
US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

TRIPOLI, Joseph S.; SHEDD, Robert D.; LIAO, Frank Y.
THOMSON multimedia Licensing Inc.
PO Box 5312 - 2 Independence Way
Princeton, New Jersey 08540
United States of America

Telephone No.
1-609-734-9497

Facsimile No.
1-609-734-9700

Teleprinter No.
219966

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

PCT/US 00/17476

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

RAMASWAMY, Kumar
9417B College Drive
Indianapolis, Indiana 46240-4102
United States of America

This person is:

- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: IN

State *(that is, country)* of residence: US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:

- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:

- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:

- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked):*

Regional Patent

☒ **AP ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ **EA Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian

☒ **EP European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line):*

☒ **AE** United Arab Emirates
☒ **AL** Albania .....
☒ **AM** Armenia .....
☒ **AT** Austria .....
☒ **AU** Australia .....
☒ **AZ** Azerbaijan
☒ **BA** Bosnia and Herzegovina .....
☒ **BB** Barbados
☒ **BG** Bulgaria .....
☒ **BR** Brazil .....
☒ **BY** Belarus .....
☒ **CA** Canada
☒ **CH and LI** Switzerland and Liechtenstein
☒ **CN** China .....
☒ **CR** Costa Rica .....
☒ **CU** Cuba .....
☒ **CZ** Czech Republic .....
☒ **DE** Germany .....
☒ **DK** Denmark .....
☒ **DM** Dominica
☒ **EE** Estonia .....
☒ **ES** Spain .....
☒ **FI** Finland .....
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☒ **GE** Georgia .....
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☒ **GM** Gambia
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☒ **IL** Israel .....
☒ **IN** India .....
☒ **IS** Iceland
☒ **JP** Japan .....
☒ **KE** Kenya .....
☒ **KG** Kyrgyzstan .....
☒ **KP** Democratic People's Republic of Korea .....
☒ **KR** Republic of Korea .....
☒ **KZ** Kazakhstan .....
☒ **LC** Saint Lucia
☒ **LK** Sri Lanka
☒ **LR** Liberia
☒ **LS** Lesotho .....
☒ **LT** Lithuania
☒ **LU** Luxembourg
☒ **LV** Latvia
☒ **MA** Morocco .....
☒ **MD** Republic of Moldova .....
☒ **MG** Madagascar .....
☒ **MK** The former Yugoslav Republic of Macedonia .....
☒ **MN** Mongolia
☒ **MW** Malawi .....
☒ **MX** Mexico .....
☒ **NO** Norway
☒ **NZ** New Zealand .....
☒ **PL** Poland .....
☒ **PT** Portugal .....
☒ **RO** Romania
☒ **RU** Russian Federation .....
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☒ **TJ** Tajikistan .....
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☒ **UG** Uganda .....
☒ **US** United States of America .....
☒ **UZ** Uzbekistan .....
☒ **VN** Viet Nam .....
☒ **YU** Yugoslavia .....
☒ **ZA** South Africa .....
☒ **ZW** Zimbabwe .....

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

☒ AG Antigua and Barbuda BZ Belize DZ Algeria .....
☒ MZ Mozambique .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) (05.10.99) 05 October 1999	60/157,706	US		
item (2) (08.06.00) 08 June 2000	60/210,257	US		
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): (2)

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA/EP

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country (or regional Office)

Box No. VIII CHECK LIST: LANGUAGE OF FILING

This international application contains the following **number of sheets:**

request	:	4
description (excluding sequence listing part)	:	28
claims	:	2
abstract	:	1
drawings	:	22
sequence listing part of description	:	
Total number of sheets	:	57

This international application is **accompanied** by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☒ copy of general power of attorney; reference number, if any: (4)
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☒ other *(specify)*: PTO-1382 and Return Receipt Post Card

Figure of the drawings which should accompany the abstract: 21

Language of filing of the international application: English

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Frank Liao

Frank Y. Liao, Patent Counsel
THOMSON multimedia Licensing Inc.

For receiving Office use only (26.06.00)

1. Date of actual receipt of the purported international application: 414 Rec'd PCT/PTO 26 JUN 2000
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA/EP
6. ☐ Transmittal of search copy delayed until search fee is paid.

2. Drawings:
☐ received:
☐ not received:

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

PCT

PCT/US 00/17476
RO/US 25 AUG 2000

POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCT Rule 90.4)

The undersigned applicant(s) *(Names should be indicated as they appear in the request):*

RICHARDSON, John William
RAMASWAMY, Kumar

hereby appoints (appoint) the following person as: __X__ agent _____ common representative

Name and address
(Family name followed by given name; for a legal entity, full official desination. The address must include postal code and name of country.)

TRIPOLI, Joseph S.
SHEDD, Robert D.
LIAO, Frank Y.

THOMSON MULTIMEDIA LICENSING INC.
P.O. Box 5312
Princeton, New Jersey 08543-5312
United States of America

to represent the undersigned before __X__ all the competent International Authorities
_____ the International Searching Authority only
_____ the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: SYSTEM AND METHOD FOR PROVIDING POTS SERVICES IN DSL ENVIRONMENT IN EVENT OF FAILURES

Applicant's or agent's file reference: RCA90195

International application number (if already available):

filed with the following Office UNITED STATES PATENT AND TRADEMARK OFFICE as receiving Office and to make or receive payments on behalf of the undersigned.

Signature of the applicant(s) *(where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power):*

John William Richardson — 7/31/00 *Date*

Kumar Ramaswamy — *Date*

Form PCT/Model of power of attorney (for a given international application)

PCT

POWER OF ATTORNEY

(for an international application filed under the Patent Cooperation Treaty)

(PCT Rule 90.4)

The undersigned applicant(s) *(Names should be indicated as they appear in the request):*

RICHARDSON, John William
RAMASWAMY, Kumar

hereby appoints (appoint) the following person as: ___X___ agent _____ common representative

Name and address
(Family name followed by given name; for a legal entity, full official desination. The address must include postal code and name of country.)

TRIPOLI, Joseph S.
SHEDD, Robert D.
LIAO, Frank Y.

THOMSON MULTIMEDIA LICENSING INC.
P.O. Box 5312
Princeton, New Jersey 08543-5312
United States of America

to represent the undersigned before ___X___ all the competent International Authorities
_____ the International Searching Authority only
_____ the International Preliminary Examining Authority only

in connection with the international application identified below:

Title of the invention: SYSTEM AND METHOD FOR PROVIDING POTS SERVICES IN DSL ENVIRONMENT IN EVENT OF FAILURES

Applicant's or agent's file reference: RCA90195

International application number (if already available):

filed with the following Office UNITED STATES PATENT AND TRADEMARK OFFICE as receiving Office and to make or receive payments on behalf of the undersigned.

Signature of the applicant(s) *(where there are several applicants, each of them must sign; next to each signature, indicate the name of the person signing and the capacity in which the person signs, if such capacity is not obvious from reading the request or this power):*

John William Richardson — *Date*

/ Kumar Ramaswamy — 2 10th August, 2000

Kumar Ramaswamy — *Date*

Form PCT/Model of power of attorney (for a given international application)

This sheet is not part of and does not count as a sheet of the international application.

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International application No. **PCT/US 00/17476**

Date stamp of the receiving Office **26 JUN 2000** (26.06.00)

Applicant's or agent's file reference **RCA90195**

Applicant
THOMSON LICENSING S.A.

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE . . . . . **240.00** T — 240
2. SEARCH FEE . . . . . **990.00** S — 925

   International search to be carried out by _____

   (If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

   Basic Fee

   The international application contains **57** sheets.

   first 30 sheets . . . . . **427.00** b1 — 427

   27 remaining sheets x **$10.00** additional amount = **270.00** b2 — 270

   Add amounts entered at b1 and b2 and enter total at B . . **697.00** B — 697

   Designation Fees

   The international application contains **109** designations.

   8 number of designation fees payable *(maximum 8)* x **92.00** amount of designation fee = **736.00** D — 736

   Add amounts entered at B and D and enter total at I . . . . . **1,433.00** I — 1433

   (Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the

4. FEE FOR PRIORITY DOCUMENT *(if applicable)* . . . . . **30.00** P — 30
5. TOTAL FEES PAYABLE . . . . . **2,693.00** TOTAL — 2693

   Add amounts entered at T, S, I and P, and enter total in the TOTAL box

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

- ☒ authorization to charge deposit account (see below)
- ☐ bank draft
- ☐ coupons
- ☐ cheque
- ☐ cash
- ☐ other *(specify):*
- ☐ postal money order
- ☐ revenue stamps

DEPOSIT ACCOUNT AUTHORIZATION *(this mode of payment may not be available at all receiving Offices)*

The RO/ **US**

- ☒ is hereby authorized to charge the total fees indicated above to my deposit account.
- ☒ *(this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit)* is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.
- ☒ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

07-0832	**26 June 2000**	
Deposit Account No.	Date *(day/month/year)*	Signature

POWER OF ATTORNEY
THOMSON LICENSING S.A.

We, THOMSON LICENSING S.A.
46, quai Alphonse Le Gallo
92648 Boulogne Cedex - France

do hereby grant Joseph S. Tripoli
Senior Vice President
THOMSON multimedia Licensing Incorporated
Two Independence Way
Princeton, New Jersey 08540

a revocable, non-exclusive and delegable power of attorney to act for us (including the signing of requisite documents) in proceedings concerning patents and applications for patents, including international and other multi-country patents and applications for patents, in our name in the Patent Offices in all countries worldwide from January 1, 1999.

Dated this 6th day of APRIL, in the year 1999.

Signed :

Didier HUCK
Chairman of the Board of Directors

POWER OF ATTORNEY
THOMSON LICENSING S.A.

We,

THOMSON LICENSING S.A.
46, Quai A. Le Gallo
92648 Boulogne Cedex
France

do hereby grant

Eric P. Herrmann
Dennis H. Irlbeck
Joseph J. Laks
Irwin M. Krittman
Vice Presidents
Thomson Multimedia Licensing Inc.
Two Independence Way
Princeton, New Jersey 08540

a revocable, non-exclusive and delegable power of attorney to act for us (including the signing of requisite documents) in proceedings concerning patents and applications for patents, including international and other multi-country patents and applications for patents, in our name in the Patent Offices in all countries worldwide from January 1, 1999.

DATED this 6th day of March, in the year 2000.

SIGNED

Joseph S. Tripoli
Senior Vice President
Thomson Multimedia Licensing Inc. and
Attorney In Fact for
THOMSON LICENSING S.A.

WITNESS: Dawda Jonaotto March 6, 2000
DATE

PCT/US 00/17476

POWER OF ATTORNEY
THOMSON LICENSING S.A.

THOMSON LICENSING S.A.
46, Quai A. Le Gallo
92648 Boulogne Cedex, France

does hereby grant

Robert D. Shedd
Patent Counsel
Thomson Multimedia Licensing Inc.
Two Independence Way
Princeton, New Jersey 08543

a revocable, non-exclusive and delegable power of attorney to act for us (including the signing of requisite documents) in proceedings concerning patents and applications for patents, including international and other multi-country patents and applications for patents, in our name in the Patent Offices in all countries worldwide from January 1, 1999.

DATED this 21st day of December, 1999.

SIGNED (signature) Irwin M. Krittman

Irwin M. Krittman
Vice President
Thomson Multimedia Licensing Inc. and
Attorney In Fact for
THOMSON LICENSING S.A.

WITNESS Davida Fornarotto

POWER OF ATTORNEY
THOMSON LICENSING S.A.

THOMSON LICENSING S.A.
46, Quai A. Le Gallo
92648 Boulogne Cedex, France

does hereby grant

Frank Y. Liao
Patent Counsel
Thomson Multimedia Licensing Inc.
Two Independence Way
Princeton, New Jersey 08543

a revocable, non-exclusive and delegable power of attorney to act for us (including the signing of requisite documents) in proceedings concerning patents and applications for patents, including international and other multi-country patents and applications for patents, in our name in the Patent Offices in all countries worldwide from January 1, 1999.

DATED this 21st day of December, 1999.

SIGNED _____
Irwin M. Krittman
Vice President
Thomson Multimedia Licensing Inc. and
Attorney In Fact for
THOMSON LICENSING S.A.

WITNESS _____

SYSTEM AND METHOD FOR PROVIDING POTS SERVICES IN DSL ENVIRONMENT IN EVENT OF FAILURES

INTRODUCTION

The present invention generally relates to a communication system and method, and more particularly to a system and method of providing voice service, for example, POTS, in the event of system failures. This invention is applicable to, for example, a DSL communication system.

BACKGROUND OF THE INVENTION

With the increasing popularity of the Internet, more and more business and residential customers are demanding high-speed broadband access. Broadband access may be provided via different types of physical medium, such as cable, satellite or traditional copper, telephone wires.

Since telephone wires typically represent high percentage of penetration in existing homes and businesses, various innovations have been proposed to increase the bandwidth of the existing telephone local plant. One such innovation is, for example, a modem which may operate with a speed of up to 56 kbps. Another innovation is Digital Subscriber Line (DSL) service. DSL service uses existing copper local loop for providing services to an end user. Another attraction of DSL is that it is capable of providing both high-speed data service and telephony voice service using the same telephone wire pair.

A generic network topology for DSL is illustrated in Fig. 1. DSL service is delivered over regular telephone wires 2-1 or 2-2 using DSL Access Multipexers (DSLAMs) 3 in a central office. For customers who receive only data service over DSL, the service is terminated at the customer premises with a DSL modem or router, shown as CPE equipment 4.In a traditional system offering DSL data only services, the POTS service coexists with the DSL service since POTS signaling is in baseband and DSL exists in a higher frequency band on the same wire coming to/from the customer premises. At both the customer premises site and the central office, POTS splitters 15 and 17 function to split the POTS signal from the data signal. The POTS signal is routed to the traditional voice network 14 at the central office and DSL data is routed to DSLAM 3, as shown in Fig. 1.

The next generation of devices have attempted to enhance the value of the DSL link by adding value added services such as digital voice links on this network. In such a model, digitized (and possibly compressed for bandwidth efficiency) voice is carried along with data over the DSL link. For combined voice and data service, DSL service is terminated by a device that provides integrated voice and data access, shown as CPE 5 in Fig. 1. Such devices typically offer an Ethernet port 6 for data and multiple analog POTS ports, for example, 7-1 and 7-2 for voice.

A DSLAM 3 serves as a packet multiplexer, typically delivering traffic from multiple customers over a high-speed uplink 8 to a metropolitan or regional packet network 9. The data network typically consists of an ATM switch. The packet protocol uses by the DSLAMs are packet protocols such as ATM or frame relay to support voice and data. Since the main data service used by DSL customers is accessing the Internet 11, the packet network is connected to the Internet, typically through a device known as a Subscriber Management System 12. Connection to an intra or enterprise data networks may also be used, to support home-based workers, for example.

A voice gateway 13 is used to deliver voice services to DSL customers. The voice gateway 13 connects the packet network to the public switched telephone network (PSTN) 14. Digital voice streams are converted into packet format for transport over the packet network between the voice gateway and the integrated access device on the customer premises. The voice gateway connects to the PSTN via a telephone switch, for example, a Class 4 or 5 switch.

Since the voice gateway 13 represents a digital access network from the point of view of the telephone switch, the connection between the gateway and the telephone switch typically makes use of a standard interface for digital loop carrier system such as GR-303, TR-008 or V5. This class of signaling is known as in-band signaling. There is a second class of signaling employed to communicate with a more intelligent digital loop carrier or edge device. This signaling stack is known as SS7 and represents an out-of-band signaling paradigm. The connection of the edge device to the telephone through the SS7 protocol stack is a link that is logically separate from the synchronous timeslots used in the class of in-band signaling protocols. What has been described so far is the known generic architecture for implementing a DSL service.

In addition to the traditional data and POTS services, various equipment manufacturers are introducing equipment for integrated digital voice and data services over DSL. As an example, Coppercom Communications Inc., of California provides equipment to DSL service providers for offering DSL services. In particular, the company has

proposed a CopperComplete™ DSL architecture, shown for example, in Fig. 2.

The system architecture provided by CopperComplete™ DSL uses a voice gateway 21 behind the ATM switch 22. The voice gateway 21 is an additional piece of equipment that converts the packetized voice traffic to voice signals acceptable to the PSTN (Public Switched Telephone Network) via a Class 5 switch 23. The voice gateway 21 converts the incoming ATM Adaptation Layer 2 (AAL2) cells to time division multiplexed voice signals and sends it to the Class 5 switch 23 using multiple T1 trunks 24. This interface is, for example, GR-303 interface, the same as used by digital loop carriers (DLC), as described before in connection with Fig. 1.

It is believed the voice path used in the Coppercom architectures is a permanent virtual circuit (PVC) that is configured during the provisioning of the CPE device, not in real time. This PVC carries all voice traffic as well as signaling traffic. The packet architecture used is ATM Adaptation Layer 2 (AAL2) for ATM encapsulation.

AAL2 has the ability to allow multiple connections multiplexed on one virtual circuit (VC). The multiplexing of multiple streams of data is done at the ATM Adaptation Layer. ATM adaptation only takes place at the endpoints of an ATM network. Cells in an ATM network are routed or switched based upon their virtual path/virtual channel (VP/VC) identifier. In the case of a permanent virtual circuit (PVC), as in the case of the Coppercom architecture, the cells are switched to the same permanent destination previously established at the time of the CPE provisioning.

The Coppercom architecture does not use the ATM network to setup and teardown the voice connections, but instead uses the voice gateway. It is, therefore, not possible to take advantage of the ATM network for switching of individual voice calls. This is because, as explained previously, in the Coppercom architecture, multiple voice calls are multiplexed along with signaling data onto a single ATM virtual circuit. The contents of the ATM cell stream are transparent to the ATM network. The ATM network only examines the header to ensure they are sent to the correct destination. The call assignment or switching in this architecture is independent of the ATM network. The call assignment cannot be determined until the signaling and voice data is de-multiplexed at the voice gateway.

SUMMARY OF INVENTION

Present inventors recognize that there are several drawbacks to prior DSL architectures. By using ATM AAL2 to carry voice, these architectures add significant cost and complexity to the end user equipment in terms of compression (when applicable), silence

suppression, variable packet fill delay settings. In addition, there will be the need to multiplexing multiple streams of data onto one ATM virtual circuit at the CPE. Further, these architecture do not allow you to take direct advantage of the ATM network (e.g., the ATM switch) in terms of the dynamic capabilities of connection setup and teardown, resulting in inefficient use of system resources.

Therefore, present inventors have arrived at a better solution of using ATM AAL1 for carrying voice traffic, instead. AAL1 provides a simple method of carrying voice through an ATM network as well as the ability to dynamically setup and teardown connections at the ATM layer within the ATM network itself (see, e.g., *ITU-TI.363.1: B-ISDN ATM Adaptation Layer Specification: Type 1 AAL*).

Hence, one aspect of the present invention is a communication architecture whose voice path is based on a combination of a PVC and a switched virtual circuit (SVC). The PVC is setup from the CPE to the trunk port on the DSLAM. The SVC is the dynamic connection that can exist in the ATM switch for the purposes of setting up and tearing down voice connections. Each voice path is carried in an independent ATM virtual circuit, rather than multiplexing multiples of them together. The voice traffic is carried using AAL1. The signaling information is also carried independently of the voice and is also routed towards a service control processor rather than directly to the switch.

In this architecture, the value of the virtual path/virtual channel directly identifies the information contained within the cell and the user it is intended for. By using an independent ATM virtual circuit per voice channel, it is possible to setup and teardown the connection in the ATM switch (using a switched virtual circuit).

A service control processor externally controls the switch through inband signaling. This architecture exploits the power of the ATM switch by using its capabilities to dynamically setup and teardown connections. In this architecture, there is no decision making at the ATM Adaptation layer in the ATM network, the data is sent to the correct destination based upon the VP/VC. This connection is established at the ATM Layer.

In another aspect of the invention, the present inventors recognize that in a traditional DSL system, a POTS (Plain Old Telephone Service) splitter is typically used to terminate the DSL data connection at the DSLAM and the POTS service at the telco. switch. This is for example, shown in an embodiment shown in Fig. 1. By having the telephone connection terminating at the telco switch there exists a

"lifeline" service because the POTS service is powered independently at the telephone company central office rather than from the consumers home or place of business. If a power outage were to happen, POTS service would still be available.

On the other hand, in a voice enabled DSL system, where the primary and secondary voice lines are carried in the DSL spectrum rather than in POTS, there exists a problem of not having the lifeline telephone service in the event of a power outage. In order to keep the lifeline service you could use the voice enabled DSL system to offer only additional secondary phone lines and rely on traditional POTS for primary telephone service. In this scenario, as previously described, POTS is terminated at the telephone company switch, and there does not exist a concentration function for primary voice lines in the voice enabled DSL network. The concentration function can only be achieved for the secondary voice lines. This is undesirable from the DSL service provider standpoint. A one-to-one mapping of telco. switch terminations per POTS line will need to be secured from the telephone company.

Therefore, a system and method are presented which solve the problem of offering POTS from the DSL network and also enable the DSL service provider to concentrate the primary and secondary telephone traffic locally. This means a DSL service provider does not need to have a one-to-one mapping per POTS line. This invention provides a piece of equipment to the DSL network. This can be integrated into the traditional DSLAM or can be an entirely different piece of equipment. The piece of equipment functions as a POTS terminator and digitizer. The function of this entity is to terminate the POTS line, for example, at the central office and digitize the voice, convert it to ATM, and then terminate it into the DSL network at the point of the ATM switch. The POTS terminator has similar functionality to the customer CPE device 33-1 in Fig. 3, in terms of signaling and digitization of the voice signal and converting the signal into an ATM format. All voice ports on the customer CPE device can be carried through the DSL network, and in the event of a power failure, a relay or a switch in the CPE device can connect one of the phones directly to the POTS line.

A system and method are thus presented for providing a telephone service. An analog signal is received from a telephone and the analog signal is converted into a digital signal in a first format. A modem is provided for receiving the digital signal in the first format. A digitizer is also provided for receiving the analog signal from the telephone. The system, in a first mode of operation, couples the digital signal in the first format to the modem, and in a second mode of operation, couples the analog signal from the telephone to the digitizer. The second mode of operation may be, for example, a failure mode of operation. It

is also important to note that this aspect of the invention may be applied to other DSL architectures (e.g., shown in Fig. 1 or 2), as well as the improved architecture shown in Fig. 3 of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a block diagram of a known DSL architecture for providing services.

Fig. 2 shows a block diagram of another DSL architecture for providing both voice and data services.

Fig. 3 is a system diagram of a DSL system according to the principles of the present invention.

Fig. 4 shows an exemplary detailed embodiment of a CPE unit in circuit block diagram form.

Fig. 5 shows a block diagram for performing a downlink operation within FPGA 45.

Fig. 6 shows an uplink ATM Cell Encapsulation Interworking Function.

Fig. 7 shows the operational scenario diagram for placing or initiating a call.

Fig. 8 shows the scenario diagram for the call in process operational sequence.

Fig. 9 shows the scenario diagram for the CPE call disconnect operational initiated by an CPE.

Fig. 10 shows the operational scenario diagram for incoming call.

Fig. 11 shows the operational scenario diagram a call disconnect initiated by the telco switch or NCS.

Fig. 12 shows a block diagram of and GR-303 interface.

Fig. 13 shows an exemplary embodiment of a SCP in distributed environment.

Fig. 14 is a block diagram that shows how voice channels are allocated between a CPE and the Telco, through a SCP.

Fig. 15 shows the logical flow of the data paths between CPE and NCS.

Fig. 16 is another block diagram of the data paths between the CPEs and the NCS.

Fig. 17 illustrates how voice data paths are set as variable bit rate (VBR) while the command and PC paths are set as unspecified bit rate (UBR).

Fig. 18 is an example of the data paths for voice traffic through the NCS.

Fig. 19 is an example block diagram of where throughput can be reduced for a system consisting of 6 CPEs.

Fig. 20 is shows the traditional method of offering POTS service through DSL network.

Fig. 21 is an embodiment of a way to offer POTS service in accordance with the principles of the present invention.

Fig. 22 is an exemplary block diagram of a POTS digitizer or terminator for providing POTS service in accordance with the principles of the present invention.

DETAILED DESCRIPTION

An exemplary embodiment according to the principles of the present invention is shown in Fig. 3.

The System Block Diagram 30 is composed of several functional blocks. The System Domain 300 is composed of Central Office (CO) Equipment domain 31 (also refers to as Network Control System (NCS) hereinafter) and Customer Premise Equipment (CPE) domain 32. The component blocks within the System Domain and their respective interfaces are:

Customer Premise Equipment (CPE) Unit 33-n

Digital Subscriber Line Access Multiplexer (DSLAM) 34

ATM Switch 35

Internet Gateway 36

Service Control Processor (SCP) 37

CPE Unit 33-n

The CPE unit 33-n consists of an internal DSL Modem unit that interfaces with, for example, up to 4 separate analog telephones

38-1 to 38-4 (via POTS) and one 10Base-T Ethernet connection 39. From the customer's analog end, the CPE device, for example, 33-1, accepts the analog input from each of the telephones 38-1 to 38-4, converts the analog input to digital data, and packages the data into ATM packets (POTS over ATM), with each connection having a unique VPI/VCI. A VPI is a Virtual Path Identifier and a VCI is a Virtual Channel Identifier. The ATM network is connection oriented which can be characterized by a VPI/VCI pair. The VPI is used to identify a virtual path that exists over a physical medium. The VCI is used to identify the virtual channel within a virtual path. This leads to the concept of a PVC(permanent virtual circuit) or a SVC (switched virtual circuit). A PVC is a connection between two endpoints and is usually manually configured. It is a path from end-to-end established using VPI/VCI value pairs at each node along the way through the ATM network. A SVC is similar to a PVC, except it is setup or torn down on a demand basis using a signaling protocol.

The Ethernet data is also encapsulated into ATM cells with a unique VPI/VCI. The ATM cell stream is sent to an internal DSL Modem within the CPE unit to be modulated and delivered to the DSLAM 34.

From the DSLAM end, the DSL signal is received and demodulated by the CPE DSL Modem and delivered to VPI/VCI Detection processing. The ATM cell data with VPI/VCI matching that of the end user's telephone is then extracted and converted to analog POTS to be delivered to one of the telephones 38-1 to 38-4. The ATM cell data with VPI/VCI matching that of the end user's Ethernet connection is extracted and delivered to an internal Ethernet transceiver for delivery to the Ethernet port. The above process will be described in depth in connection with detailed description of the CPE and components below.

DSLAM 34

The DSLAM 34 demodulates the data from multiple DSL modems 33-1 to 33-n and concentrates the data onto, for example, an ATM backbone network for connection to the rest of the network. The DSLAM 34 provides back-haul services for packet, cell, and/or circuit based applications through concentration of the DSL lines onto ATM outputs to the ATM Switch 35.

ATM Switch 35

The CO ATM switch 35 is the backbone of the ATM network. The ATM switch performs various functions in the network, among them:

- Cell Transport
- Multiplexing and concentration

- Traffic Control
- ATM-layer management

Of particular interest in the System Domain 30, the ATM switch provides for the cell routing and buffering in connection to the DSLAM 34, Service Control Processor 37 and the Internet Gateway 36, and T1 circuit emulation support in connection with the Public Switch 40 that handles voice telephone calls.

One exemplary embodiment of an ATM switch may be a Newbridge MainStreetXpress 36170 Multiservices Switch (Newbridge 36170). This switch has DSLAM capability and individual DS0 control capability via T1 Circuit Emulation cards. It is possible that neither the DSLAM capability nor the DS0 control will be integrated into the switch, but rather in discrete components.

Another exemplary embodiment of an ATM switch may be a Lucent Access Concentrator with optional T1 cards added. The concentrator functions as the routing mechanism to aggregate and disperse data to various destinations within and outside the NCS, under the control of the SCP 37.

In one embodiment of the invention, optional T1 cards are installed in the ATM switch that allow ATM cells to be placed onto a DS0 timeslot as part of a T1 connection. There may be, for example, 6 T1 ports per card. In this case, the T1 card is connected to the Telco's switching network.

Another exemplary interface from the ATM switch 37 to the telco switch 40 may be via a GR-303 interface. The GR-303 interface defines an Interface Group (IG) which may contain from 1 to 28 DS1 connections. Channels 12 and 24 are used for control information on the first DS1 connection. If there is a second DS1 in the IG, it contains redundant control information on channels 12 and 24 also. These channels are only used on the first 2 DS1 connections. All other DS1 connections utilize all 24 channels for voice traffic.

For the 1 or 2 DS1s that contain control information, channel 12 is used as the Timeslot Management Channel (TMC) and channel 24 is used as the Embedded Operations Channel (EOC).

A block diagram of this interface is shown in Fig. 12.

Internet Gateway 36

The Internet Gateway 36 provides for the ATM signaling support of internetworking of IP over ATM in connection to and from the ATM switch 35. An exemplary embodiment of an Internet Gateway may be

a Cisco 7200 Series High Performance Router. This router has the capacity for four ATM ports and 32 10Base-T Ethernet ports. Other models may also be chosen based on capacity and performance.

Service Control Processor (SCP) 37

The SCP 37 provides for address translation, demand assignment and call management functions similar to an Internet Domain Name Service (DNS) server. The SCP 37 would be available for other functions as well, such as downloading code to the CPE and bandwidth and call management (e.g., busy) functions as well as other service provisioning and setup tasks.

One exemplary embodiment of a SCP is a Performance 500 series PC, on sale from Gateway, populated with one or two Fore Systems ForeRunnerHE 155 ATM Server Adapters. The ForeRunnerHE 155 supplies the SCP with full duplex OC-3 connectivity to the Newbridge 36170 which may serve as an ATM switch. One of the ATM adapters will serve as the dedicated command link to the Newbridge 36170. If the Newbridge 36170 supports a Proxy Server type of control and if such a control channel requires a separate port, then the second ATM adapter would be installed in the SCP. This ATM adapter would then serve as the data path for a PVC between the SCP and the Newbridge 36170.

Fig. 13 shows another exemplary embodiment of an SCP in distributed environment. The decision units (CPUs) 1305-1 to 1305-n will consist of one or more off-the-shelf industrial packaged (rackmount) computers running an operating system capable of performing the functional tasks. Note that different CPUs may be running different operating systems if various software requires a specific platform in order to operate. The desired platform should be scalable so that additional processing power can be added with a minimum amount of re-work or design changes.

As shown in the figure, all components are connected via an internal private LAN 1310 (e.g., Ethernet) for ease of communication and connectivity. The data storage array 1311 comprises of network attached storage units that are connected to the LAN 1310 (e.g., an ethernet) for ease of communication and connectivity. The data storage array 1311 comprises of network attached storage units that are connected to the LAN 1310. This will allow direct access to the data through the remote access device in the event access is required for status and/or troubleshooting.

The ATM interface block 1320 is the interface that transforms ATM cells into data that can be processed by the CPUs. In an

alternative, an ATM NIC on one or more CPUs could be used for this purpose.

Control signals to and from the DSLAM and ATM switch are also required for NCS operation. They may be in-band or out-of-band signals.

Figure 14 is a block diagram that shows how voice channels are allocated between a CPE and the Telco, thru a SCP, in accordance with the present invention. A SCP - CPE logical connection is used to control the data paths between the CPE unit, the ISP and Telco. All data paths between the CPEs and the NCS will have PVCs already established. This will allow 24-hour access to the ISP and a channel that will allow the exchange of control information between the SCP and the CPE.

The voice channels will also be PVCs (each with a variable rate) but only between the CPE and the ATM switch, as shown in Fig. 14. The SCP will have to establish a connection in real time between the Telco and the voice channel, through, for example, an ATM switch, as calls are requested. This is due to the limited amount number of DS0s between the NCS and the Telco. Each voice data path will require a DS0 in order to connect up to the Telco. For economic reasons, the number of DS0s will be less than the total number of possible voice channels. Because of this, the SCP will have to dynamically allocate DS0s as required to the CPE voice channels. The SCP will be responsible for handling and establishing all voice connections for both incoming and outgoing calls to the NCS and its CPEs.

As shown in the Fig. 14, the total number of voice channels from CPEs (XN) is much greater than the number of available DS0 slots (M) leaving the NCS. Therefore, the SCP must allocate the DS0 channels dynamically as calls are connected to the CPEs. The SCP has a command channel to the ATM switch that it uses to issue commands to the ATM switch so that it can route the CPE voice channels to the T1 interface and ultimately to the Telco.

When a voice call data path to the Telco is established, the ATM switch is commanded to route the appropriate VPI/VCI to one of the DS0 slots on one of the T1 cards. The tracking of which DS0s and T1 ports are available is maintained by the SCP. All ATM cell conversions are handled by the T1 cards.

The SCP controls all aspects of the ATM switch including initial set-up. The control of the ATM switch can be achieved in one or more of the following ways:

1. through the RS232 port using terminal emulation. This is out-of-band signaling.

2. through the Ethernet port using Telnet. This is out-of-band signaling.

3. allocating a PVC between the SCP and the ATM switch. The SCP runs an SNMP client and controls the switch by using in-band signaling; and/or

4. through the use of the API on the ATM switch (the PacketStar Signaling Gateway). This is in-band signaling.

Use of in-band signaling will probably provide the fastest response from the ATM switch but with increased complexity of the interface. In addition, in-band signaling can use already established ATM data paths. This will be especially useful in the event that the SCP and the ATM switch are not co-located.

Note that out-of-band signaling can utilize the ATM data paths already in existence and provide pseudo in-band signaling. For example, through the use of Local Area Network Emulation (LANE) provided by ATM.

The SCP may communicate with the IP Internet gateway 36 through the RS232 port or by using an SNMP client via TCP/IP.

The T1 interface to the Telco switch 40 transforms the ATM cells into data that is put onto a DS0 channel and transmitted through a T1 line to the Telco switch. The reverse happens when data is received at the NCS.

The T1 interface consists of line cards that are installed as options on the ATM switch. The SCP will route data to an individual DS0 slot on a T1 card by issuing a command to the ATM switch.

Detailed CPE unit Implementation

An exemplary detailed embodiment of a CPE unit 33-n is shown in circuit block diagram form in Fig. 4. The embodiment of the CPE unit architecture may comprise of, for example, an Altera 10K100A 240 pin FPGA 45, two Alcatel MTK-40131 SH POTS Evaluation Boards 44-1 and 44-2, an Alcatel MTK-20140 DSL Modem Evaluation Package 46, and several peripheral devices such as memory SRAM 413 and Ethernet physical layer processor 420. Each of these major CPE unit components is described in detail in the paragraphs that follow. These components may be used to test and evaluate, as well as implement the principles of the present invention.

One skilled in the art will readily recognize that the components selected and described herein for implementing a CPE unit, for example, CPE 33-1, in accordance with the present invention are exemplary only. They are chosen mainly for the purpose of being able

to implement the principles of the present invention expediently, using readily available off-the-shelf products. Other circuits or integrated circuits performing the same functions of these components as described herein may also be used, as will be apparent to one skilled in the art.

Telephone Interface - Alcatel MTK-40131 SH POTS Evaluation Boards 44-1 and 44-2

The Alcatel MTK-40131 Evaluation Boards 44-1 and 44-2 are used as interface boards to POT telephones 38-1 to 38-4 (shown in Fig. 1) via RJ11 connections 41-1 to 41-4. These boards comprising functions such as, for example, Analog to Digital Conversion (A/D), Digital to Analog Conversion (D/A), and line interface control, necessary to connect analog telephone sets or other analog terminals into digital communications systems.

As shown in Fig. 4, each of the MTK-40131 Evaluation Boards contains three devices: two Short-Haul Line Interface Circuits (SH LIC) 42-n that provide the signal and power interface to the analog lines (one per line) and a DSP based CODEC (CODSP) 43-n that provides all signal processing functions for up to two independent two-wire phone lines.

The digital interface to the Alcatel MTK-40131 Evaluation Boards is the General Circuit Interface (GCI). Ring signaling, on-hook signaling, off-hook signaling, and alarm detection are all provided to the Altera FPGA 44 by the Alcatel MTK-40131 Evaluation Boards, via the GCI interface 1 or 2.

The two Alcatel MTK-40131 Evaluation Boards 44-1 and 44-2 provide analog POTS to digital interfacing for up to four analog telephones 38-1 to 38-4. Of course, more of less of these Evaluation Boards may be used and the rest of the circuit scaled up or down accordingly, to provide capacity to accommodate more or less than 4 analog telephones.

For downlink data (i.e., towards an end-user telephone), the CODSP 43-1 or 43-2 routes incoming GCI data to one of the MTC-30132 SH LIC units for D/A conversion and delivery to one of the analog phone ports 41-1 to 41-4. For uplink data (i.e., towards the network), the MTC-30132 SH LIC units 42-1 to 42-4 convert incoming phone port analog data to digital and deliver the digital data to the CODSP 43-1 and 43-2. The CODSPs then deliver the digital data to the FPGA 45 via the GCI interfaces, as pointed out previously.

ADSL Modem - Alcatel MTK-20140 Rate Adaptive ADSL Modem Evaluation Package 46

The Alcatel MTK-20140 chipset 46, as shown in Fig. 4, consists of an Analog Front-End (MTC-20144) 47 and a digital chip (MTC-20146) 48. MTC-20146 integrates three components and or functions:

- DMT (Discrete Multi-Tone) modem
- Dedicated ADSL Transceiver Controller with associated firmware
- ATM Framer

The MTK-20140 46 therefore provides all the active functions required to implement a complete ATM-based, rate adaptive DMT ADSL modem.

The data interface between the MTK-20140 46 and the Altera FPGA 45 is implemented as an ATM Utopia interface 410. The MTK-20140 also provides a POTS splitter 414 with connectivity to two RJ11 ports 49-1 and 49-2. RJ11 49-1 may be used for connection to the telephone wire pair from the central office, for example, while the other jack, 49-2, may be used for connection to an analog POTS telephone.

ATM Processing - Altera 10K100A 240 pin Field Programmable Gate Array (FPGA) 45

The Altera FPGA 45 (which will now be referred to simply as FPGA) has been programmed to provide general ATM processing for the DSL service. In particular, functions of the FPGA 45 comprise ATM cell stream processing, control signal processing, GCI interfacing to the MTK-40131 SH POTS units 44-1 and 44-2, UTOPIA interface and control to the MTK-20140 ADSL modem 46, and traffic control and shaping for the CPE unit in general.

DS0 / ATM Interworking Functions (IWF's)

On the FPGA uplink path (CPE to Network), 56 kbps data will be packaged into ATM cells as part of the ATM Cell Encapsulation function provided by FPGA 45. The 56 kbps data is the data to be carried on a DS0 channel.

The issue of how much bandwidth is required to transfer a single DS0 seems harmless and straightforward until one reads the ATM Forum's af-vtoa-0078 (*Circuit Emulation Service Interoperability Specification*) and af-vtoa-0085 (*Specifications of (DBCES) Dynamic Bandwidth Utilization – In 64 kbps Time Slot Trunking Over ATM – Using CES*) specifications.

According to af-vtoa-0078, a single DS0 could require the entire T1 bandwidth if it is the only active channel in the T1. This may be fine for a switching fabric, but it is not fine for the ADSL uplink path. The af-vtoa-0085 specification allows for not sending idle channels, but bandwidth is still consumed by ATM pointer overhead. Both specifications allow (actually necessitate) the usage of IWF's to aid in efficient bandwidth management.

In the DSL system in accordance with the present invention, the DS0 data must be packed into ATM cells as efficiently as possible (in terms of bandwidth usage). There are IWF's on both the FPGA uplink and downlink paths as well as in the network. On the CPE uplink path, the IWF packs the 56 kbps data (in octets) into an ATM cell payload, and waits until the payload is full before transmitting the cell. This introduces a small delay (about 6 msec) in the transmitted data.

On the CPE downlink path, the IWF extracts the payload data and delivers it to the MTK-40131 SH POTS unit at a rate of 56 kbps. The network IWF's are analogous to the CPE IWF's. The network IWF's may be contained in an addressable box between the ATM switch and a T1 CES card. Alternatively, there may exist a T1 CES card that performs the network IWF as needed for the DS0 data.

FPGA Downlink Path

The ADSL modem 46 sends data to the FPGA 45 via the UTOPIA interface 410. The UTOPIA data enters the Traffic Control and Shaping function 411 in FPGA, which routes the data to the internal ATM Cell Bus 412. Each of the nodes on the internal ATM Cell Bus 412 performs VPI/VCI detection and filtering on the incoming ATM cells, as shown for examples, as blocks 420-1 to 420-6.

If a VPI/VCI detection function detects a VPI/VCI match, the processing node passes the ATM cell data to the ATM cell payload extraction function, shown as blocks 421-1 to 421-6.

For the telephone ports, the ATM cell payload extraction function sends the extracted payload data to the MTK-40131 SH POTS unit via the GCI bus protocol. For the Control Process path 422, the ATM cell payload extraction function sends the extracted payload data to the Control Process function 423.

Among other things, the Control Process function 423 provides VPI/VCI assignment for the other CPE ports. For the Ethernet path, the ATM cell payload extraction function 421-6 sends the extracted payload data to the 10Base-T Physical Interface Chip (ML2653) 420.

The downlink payload extraction process for all of the ports contains an IWF (as described before) that gathers the DS0 64 kbps data from the ATM cells, and sends the data to the MTK-40131 SH POTS unit 44-1 or 44-2 at 56kbps, for further conversion to analog voice. A block diagram for performing this downlink operation within FPGA 45 is shown in Fig. 5.

In particular, the downlink Interworking Function 50 comprises a counter 51, FIFO 52 and Converter and Interface 53, whose function will be described in connection with tables 1-8 below.

As described before, an uplink ATM Cell Encapsulation Interworking Function is also needed. This is shown in Fig. 6 of the present invention.

As shown in Fig. 6, the telephone port data (via the GCI interface) and the Ethernet data 10Base-T Physical Interface Chip enter their respective ATM Cell Encapsulation functions at 60. The resulting ATM cells are sent to the VPI/VCI Generation function 420, which inserts VPI/VCI data into the cell and delivers the ATM cell to the Traffic Control / Shaping function 411. This data is then sent to the MTK-20140 ADSL modem unit 46 for transmission. The uplink ATM Cell Encapsulation function 60 for all of the ports contains an IWF that packs the DS0 data into full ATM cell payloads and delivers the data to the ADSL modem.

The CPE FPGA 45 formats an AAL1 ATM cell for the telephone ports in the manner described by tables 1 through 8 using counter 61, F1F0 62, and converter 63. The Structured Data Transfer (SDT) pointer in this system always has a value of 0x00. The sequence count field that is contained in the tables refers to the sequence count field in the SN field defined in Section 2.4.2.1 of ITU-T I.363.1. The sequence count field counter 61 is a 3 bit field that starts with a value of 0 and increments in each successive ATM cell to a maximum of 7 and then wraps to a value of 0 (modulo 8). When the SN counter is 0, the SDT pointer is present in the ATM cell. This ATM cell stuffing format is known as 1x56 with CAS. The ABCD bits (CAS bits) are placed in the ABCD order, left justified ("A" is the MSB, "D" is bit 4). The lower nibble is stuffed with 0. The CAS bits are stolen (bit robbing) from the LSB of the DS0 frames 6, 12, 18, and 24 of the Extended Superframe (ESF), composed of 24 DS1 frames plus formatting.

Sequence Count 0

Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1

7	SDT Pointer	1
31	24 DS0 Samples	24
32	CAS bits	1
53	21 DS0 Samples	21

Table 1 Sequence Count Field = 0

Sequence Count 1

Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1
9	3 DS0 samples	3
10	CAS bits	1
34	24 DS0 samples	24
35	CAS bits	1
53	18 DS0 samples	18

Table 2 Sequence Count Field = 1

Sequence Count 2

Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1
12	6 DS0 samples	6
13	CAS bits	1
37	24 DS0 samples	24
38	CAS bits	1
53	15 DS0 samples	15

Table 3 Sequence Count Field = 2

Sequence Count 3

Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1
15	9 DS0 samples	9
16	CAS bits	1
40	24 DS0 samples	24
41	CAS bits	1
53	12 DS0 samples	12

Table 4 Sequence Count Field = 3

Sequence Count 4		
Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1
18	12 DS0 samples	12
19	CAS bits	1
43	24 DS0 samples	24
44	CAS bits	1
53	9 DS0 samples	9

Table 5 Sequence Count Field = 4

Sequence Count 5		
Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1
21	15 DS0 samples	15
22	CAS bits	1
46	24 DS0 samples	24
47	CAS bits	1
53	6 DS0 samples	6

Table 6 Sequence Count Field = 5

Sequence Count 6		
Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1
24	18 DS0 samples	18
25	CAS bits	1
49	24 DS0 samples	24
50	CAS bits	1
53	3 DS0 samples	3

Table 7 Sequence Count Field = 6

Sequence Count 7		
Total Bytes	Data Type	# bytes
5	ATM Cell Header	5
6	AAL1 SAR PDU Header	1
27	21 DS0	21

	samples	
28	CAS bits	1
52	24 DS0	24
	samples	
53	CAS bits	1

Table 8 Sequence Count Field = 7

Clock Generation 425

The FS6370 EEPROM Programmable Clock Generation IC 425 provides clocking for the FPGA and several peripherals. A 16 MHz input 426 to the FS6370 is used because this frequency facilitates generation of many other needed system clock frequencies. The 20 MHz clock signal is used for Ethernet processing and the 512 kHz clock signal is used to support the GCI interface. In another implementation, a master system clock may replace this 512 kHz clock signal.

SRAM 413

A SRAM 413 will be used by the FPGA 45 as scratchpad RAM in case there is not enough memory inside the FPGA to handle all of the FIFO's and packetizing RAM needed for the ATM and Ethernet processing functions.

BIT Blaster Port 430

FPGA 45 is SRAM-based and requires configuration after power-up. The BIT Blaster port is an on-board header that is used to configure the FPGA 45 during the prototype development only. The EPC1 serial EPROM must not be installed when using the BIT Blaster port. The on-board EPC1 serial EPROM 435 will configure the FPGA during normal operations.

Ethernet Interface 420

The 28-pin ML2653, 10BASE-T Physical Interface Chip 420, is a complete physical interface for twisted pair and AUI Ethernet applications. It combines a 10BASE-T MAU, Manchester Encoder/Decoder, and Twisted Pair Interface filters in one monolithic IC. The ML2653 420 can automatically select between an AUI and twisted pair interface based on Link Pulses. The ML2653 conforms to IEEE 802.3I—1990 (10Base-T), and together with the header formation in the FPGA, it will accept and provide Ethernet packets pursuant to the G.802 standard for packet structure.

Data Path Logical Flow

Fig. 15 shows the logical flow of the data paths from the CPE through the NCS and back again (bi-directional). Also shown are the data formats used between the different functional blocks.

The voice data paths may be connected to a Telco's network via T1 links as described before. A T1 consists of 24 voice channels called DS0's as shown in. Hence each voice data path uses one of 24 DS0 channels of the T1 connection.

The voice data paths are variable bit rate (VBR) while the command and PC paths are unspecified bit rate (UBR) as shown, for example, in Fig. 17.

Fig. 16 is a block diagram of the data paths between the CPEs and the NCS.

Note that the Command and PC data paths are UBR while all of the voice paths are specified as VBR and are assigned a unique VPI/VCI for each path. Refer to the Voice Traffic Management section for a description of how the NCS manages the data path allocation for the voice channels. The voice data is formatted using as-vtoa-0078 on AAL1.

The Command channel is a non-blocking channel to the NCS (and ultimately to the SCP) so that a CPE is always in contact with the NCS. Bandwidth will have to be allocated so that the maximum number of CPEs have sufficient bandwidth to allow communication with the NCS.

The PC data path is also a non-blocking channel but could drop to a minimum bandwidth in the event of network congestion. This non-blocking channel requires that sufficient bandwidth will have to be allocated accordingly.

As ATM cells move through the NCS, the cells can have their ATM addresses (VPIs/VCIs) translated. In addition, the ATM cells that carry voice data can be blocked at the DSLAM. Fig. 16 is an example of the data paths for ATM cells from two CPEs.

In this example, there are 2 active voice channels; Voice 1 of CPE 1 and Voice 3 of CPE 2. The other voice channels are "blocked" at the DSLAM since they are not carrying any data. Refer to the Voice Traffic Management paragraph for a description of how this occurs.

Operational Call Flow Sequences

The following sections describe how each major components of the present invention operate in response to different call flow scenarios.

Fig. 7 shows the operational scenario diagram for placing or initiating a call. The sequence enumeration is further described in the paragraphs that follow.

1. One of the 4 phone lines on the CPE goes off hook.

2. The corresponding LIU signals an off hook indication to the CPE processing unit.

3. The CPE processing unit recognizes the change of state of the off hook.

4. The CPE processing unit formats an ATM cell containing a unique CPE identifier, the off hook indication, and the telephone port ID on the CPE.

5. The CPE issues the ATM cell to the network through the DSL interface.

6. The DSLAM passes the ATM cell to the ATM switch, which routes it to the SCP.

7. The Service Control Processor (SCP) recognizes the request from the CPE.

8. The SCP determines the availability of a DS0 slot connecting to the public network..

8 (a). The SCP determines that no DS0 is available.

8 (b). The SCP generates user feedback. In this case, that feedback is nothing, to emulate the telephone network when a connection to a switch is not available.

9. The SCP creates a VP/VC path connecting the available DS0 slot to the DSLAM port of the CPE.

10. The SCP checks it's database and retrieves the phone number corresponding to the CPE port.

11. The SCP informs the T1 line card of the calling (source) phone number.

12. The SCP creates an ATM cell, which contains the VP/VC of the established connection and a confirmation message of the connection.

13. The cell created by the SCP is transmitted through the ATM switch to the port of the ATM switch connected to the DSLAM and on to the CPE. This cell VP/VC terminates at the CPE processing unit.

14. The CPE processing unit receives the ATM cell.

15. The CPE processing unit configures the VP/VC generation/detection to the directed VP/VC.

16. The ATM VP/VC channel begins carrying the DS0 payload between the LIU of the CPE all the way to the T1 line emulation cards in the switch.

17. Call progress, tone generation, and tone detection proceeds between the telephone unit and the public telephone network.

Fig. 8 shows the scenario diagram for the call in process operational sequence.

Fig. 9 shows the scenario diagram for the CPE call disconnect operational initiated by an CPE. The sequence enumeration is further described in the paragraphs that follow.

1. One of the 4 phone lines on the CPE goes on hook during an established call in Progress.

2. The corresponding LIU signals an on hook indication to the CPE processing unit.

3. The CPE processing unit recognizes the change of state of the on hook.

4. The CPE processing unit formats an ATM cell containing a unique CPE identifier, the on hook indication, and the telephone port ID on the CPE.

5. The CPE issues the ATM cell to the network through the DSL interface.

6. The DSLAM passes the ATM cell to the ATM switch, which routes it to the SCP.

7. The SCP recognizes the request from the CPE.

8. The SCP informs the T1 line emulation of the call disconnect.

9. The SCP tears down VP/VC path connecting the available DS0 slot to the DSLAM port of the CPE.

10. The SCP creates an ATM cell that acknowledges the call tear down.

11. The cell created by the SCP is transmitted through the ATM switch to the port of the ATM switch connected to the DSLAM and on to the CPE. This cell VP/VC terminates at the CPE processing unit.

12. The CPE processing unit receives the ATM cell.

13. The CPE processing unit removes the VP/VC generation/detection to the disconnected port.

Fig. 10 shows the operational scenario diagram for incoming call. The sequence enumeration is further described in the paragraphs that follow.

1. The SCP initially is monitoring the status of the T1 interface connected to the public telephone network.

2. A DS0 channel indicates an incoming call.

3. The SCP determines the destination telephone number from the T1 line emulation cards.

4. The SCP looks up the CPE port ID in a database relating phone numbers and Port Ids

5. The SCP creates a VP/VC connection to the DSLAM of the CPE containing the targeted phone port.

6. The SCP creates an ATM cell containing information on the incoming call, the targeted port, and the established VP/VC. This cell is transmitted to the CPE processing unit.

7. The CPE processing unit receives the cell and configures the targeted port with the VP/VC.

8. The CPE rings the phone at the appropriate RJ11 port.

9. At this point, the connection is set up from the T1 line emulator to the telephone port of the CPE.

Fig. 11 shows the operational scenario diagram a call disconnect initiated by the telco switch or NCS. The sequence enumeration is further described in the paragraphs that follow.

1. The SCP initially is monitoring the status of the T1 interface connected to the public telephone network.

2. A DS0 channel indicates a termination of an existing call.

3. The CPE device user goes on-hook.

4. The corresponding LIU signals an on-hook condition to the CPE processing unit.

5. The CPE processing unit recognizes the change of state of the on-hook.

6. The CPE processing unit formats an ATM cell containing a unique CPE identifier, the on hook indication, and the telephone port ID on the CPE.

7. The CPE issues the ATM cell to the network through the DSL interface. The DSLAM passes the ATM cell to the ATM switch, which routes it to the SCP.

8. The SCP recognizes the request from the CPE.

9. The SCP informs the T1 line emulation of the call disconnect.

10. The SCP tears down VP/VC path connecting the available DS0 slot to the DSLAM port of the CPE.

11. The SCP creates an ATM cell that acknowledges the call tear down.

12. The cell created by the SCP is transmitted through the ATM switch to the port of the ATM switch connected to the DSLAM and on to the CPE. This cell VP/VC terminates at the CPE processing unit.

13. The CPE processing unit receives the ATM cell and removes the VP/VC generation/detection to the disconnected port.

Voice Traffic Management

Voice traffic management refers to the control of data that carries voice information throughout the NCS and how it is managed when there is less system capacity than the theoretical maximum amount of data that could pass through the system. For example, if there are 100 telephone lines connected to the NCS but only 10 DS0 lines connected to the Telco, the DS0 lines must be allocated dynamically as connections are required for each telephone connection desired.

Statistics will be used to allocate an economical amount of physical data bandwidth at various points in the system. Since this number will be less than the theoretical maximum amount of data, there are

different points in the system where data blocking could occur (i.e., a voice connection cannot be completed). The SCP will be responsible to manage the allocation of data channels as requested. And, in the event that a request cannot be fulfilled, the SCP is responsible to gracefully exit from that condition and inform the requesting entity of the non-compliance.

Fig. 18 is an example of the data paths for voice traffic through the NCS. Note that each CPE shows a voice channel going to the NCS via a PVC.

As shown in the figure, there is a potential of a call being blocked at the DSLAM or at the Telco switch. The potential block at the DSLAM is determined by the size of the DSLAM-to-ATM switch data path. The potential block at the Telco switch is determined by the number of DS0 lines.

Each voice channel PVC is established when the CPE is connected to the system. The PVC is specified as a Variable Bit Rate (VBR). This allows the DSLAM and ATM switch to be "over subscribed". That is, the ATM switch will allow all of the connections to be established since they are set up as VBR. The CPE will not transmit data on any voice channel until commanded to do so by the SCP.

In the example shown in Fig. 18, each DSLAM has only enough bandwidth to support a single voice channel to the ATM switch. However, it is possible that 3 channels could attempt to establish a connection. Prior to a connection, none of the CPEs are transmitting data on the voice channel, therefore the DSLAM is not passing data to the ATM switch. This allows the DSLAM-to-ATM switch to be completely unused in this example. Once a connection is established between a CPE (e.g., CPE 2) and the Telco, the SCP will command CPE 2 to start transmitting voice data on its data channel. Now the data path between DSLAM 1 and the ATM switch is full. No other voice connections can be made until CPE 2's connection is removed. Even though a PVC has been established between each CPE and the ATM switch, the SCP has control over the allocation of bandwidth by commanding each CPE to transmit or not transmit voice data.

Non-Voice Traffic Management

The data paths that do not carry voice data (i.e., the Command and PC data channels) are non-blocking and will have a minimum bandwidth available for each path. Traffic management is less of a concern for the SCPs in this case since the initial set-up of each data path will specify the path as UBR with a minimum data rate. The ATM devices will enforce this data rate as a function of the

ATM protocol itself. As system throughput changes, the bandwidth for each channel will adjust accordingly based on the amount of data attempting to be passed through that channel.

This will require that each potential "choke point" in the data path must be implemented so that it will be able to handle the minimum amount of required bandwidth for the number of CPEs connected to the NCS.

Fig. 19 is an example block diagram of where throughput can be reduced for a system consisting of 6 CPEs.

Each of the PVCs in the figure has a potential to be limited at each location as indicated. Therefore, each device in that data path must be able to accommodate the required amount of bandwidth (including transmission protocol overhead) for all non-blocking data channels connected to the system.

Enhanced POTS Services

As mentioned before, the present inventors recognize the need to provide a POTS service which is immune to, for example, power failure at the customer site and also possesses the ability to be statistically concentrated for efficient use of bandwidth.

The standard plain old telephone service (POTS) line that enters the home is powered by the central office line card using a battery or a generator. In the event of a power outage at the residence, this telephone service is still available, even if a subscriber is subscribing to a DSL service.

Figure 20 shows a traditional way to terminate an analog POTS service to the incumbent local exchange carrier (ILEC) switch, while subscribing to a DSL service. This architecture uses a POTS splitter 2001 and another POTS splitter 2002 at respective end of customer termination and the central office. In the event of a power failure at the customer site, POTS splitter 2001 will automatically bypass the CPE processing at the customer site and POTS splitter 2002 will route this POTS traffic to a telco switch 2003 via analog voice path 2004. One skilled in the art would readily recognize that this architecture of providing a POTS service is applicable to the systems shown in either Fig. 1, 2 or 3.

Although the architecture shown in Fig. 20 is certainly able to continue to provide POTS service in the event of, for example, a power failure, the present inventors recognize several drawbacks with this architecture. First, there is no way to statistically concentrate the POTS traffic before the POTS traffic reaches the LEC switch.

Additionally, a competitive local exchange carrier (CLEC), such as a DSL provider, is unable to manage and provision the analog telephone service as part of its offering, since he or she is still relying on terminating this backup POTS traffic directly on the ILEC switch.

Fig. 21 shows an enhanced system and method of offering POTS through a DSL network to overcome the disadvantages of the architecture described above. As shown in Fig. 21, a POTS digitizer 2105 is added to the network. The POTS digitizer 2105 is coupled between a POTS splitter 2102 and an ATM switch 2106. The function of this equipment 2102 is to terminate the analog POTS line, digitize the voice, convert it to ATM, and then terminate it into the DSL network at the point of the ATM switch 2106. This piece of equipment have similar functionality as the customer CPE device as shown in Figs. 3 and 4 and described before in terms digitizing analog voice, converting the digitized voice to an ATM stream and signaling and communicating with a Service Control Processor.

In Fig. 21, POTS splitters or switches 2101 and 2102 would route POTS traffic to the POTS digitizer automatically, in an event of power failure at the customer site. This could be done in many known ways, such as, for example, under the control of a CPU when it detects that the power supply line has dropped below a certain threshold. The CPU will then switch the connection from the telephone to the POTS terminator or digitizer 2105. In addition, although POTS splitter 2101 is shown as a separate unit from CPE 33-1, it could be incorporated as part of the CPE unit as shown for example, as element 414 of the CPE unit shown in Fig. 4.

Fig. 22 shows a detailed block diagram of an exemplary POTS digitizer or terminator in accordance with the present invention. The device comprises POTS line cards 2201-1 to 2201-n, ATM cell processors 2202-1 to 2202-n and Statistical Multiplexes 2203. The functions of the POTS line cards are similar to that already described for interfaces 44-1 or 44-2 of the CPE device, as shown in Fig. 4. Likewise, the functions of the ATM cell processor 2202-1 to 2202-n are similar to that already described for ATM processing section 45 of the CPE device, as shown in Fig. 4. Statistical mux 2203 will then provide multiplexing function to multiplex available ones of the ATM data packets into a DS1 or higher stream as shown in Fig. 22, for coupling to a telco switch, for example.

The enhanced architecture described above for offering POTS through a DSL network, as shown in Fig. 20, therefore gives a DSL network operator the ability to manage all telephone service on a DSL network. The architecture is also able to provide POTS telephone service in the event of, for example, a power failure at the customer site, since the

additional piece of equipment 2105 is being powered by either a battery or a generator at the central office.

Claims

1. A system for providing a telephone service, comprising:

a device for receiving an analog signal from a telephone and converting the analog signal into a digital signal in a first format;

a modem for receiving the digital signal in the first format;

a digitizer for receiving the analog signal from the telephone;

the device, in a first mode of operation, coupling the digital signal in the first format to the modem; and in a second mode of operation, coupling the analog signal from the telephone to the digitizer.

2. The system of claim 1 wherein the telephone service is a POTS.

3. The system of claim 1 wherein the digital signal in the first format is coupled to the modem via a digital subscriber loop.

4. The system of claim 1 wherein the analog signal from the telephone is coupled to the digitizer via telephone wires.

5. The system of claim 3 wherein the analog signal from the telephone is coupled to the digitizer via a telephone wires.

6. The system of claim1 wherein the modem further converts the received digital signal in the first format to a digital signal in a second format.

7. The system of claim 6 wherein the digitizer further converts the received analog signal from the telephone to a digital signal in a third format.

8. The system of claim 7 wherein the second format is the same as the third format.

9. The system of claim 1 wherein the second mode of operation is a power failure mode of operation.

10. A method for providing a telephone service, comprising the steps of:

receiving an analog signal from a telephone and converting the analog signal into a digital signal in a first format;

coupling the digital signal in the first format to a modem in a first mode of operation; and

coupling the analog signal from the telephone to a digitizer, in a second mode of operation.

11. The method of claim 10 wherein the telephone service is a POTS.

12. The method of claim 10 wherein the first coupling step is done via a digital subscriber loop.

13. The method of claim 10 wherein the second coupling step is done via a digital subscriber loop.

14. The method of claim 12 wherein the second coupling step is done via a digital subscriber loop.

15. The method of claim 10 further comprising the step of converting the received digital signal in the first format to a digital signal in a second format at the modem.

16. The method of claim 10 further comprising the step of converting the received analog signal from the telephone into a digital signal in a third format at the digitizer.

17. The method of claim 16 wherein the second format is the same as the third format.

18. The method of claim 10 wherein the second mode of operation is a power failure mode of operation.

19. An apparatus, comprising:

an interface for coupling to a telephone;

processor for converting an analog signal from the telephone to a digital signal; and

a switch, in a first mode of operation, for coupling the digital signal to a modem; and in a second mode of operation, for coupling the analog signal from the telephone to a digitizer.

20. The apparatus of claim 19 wherein the second mode of operation is a failure mode.

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ABSTRACT

A system and method are presented for providing a telephone service. An analog signal is received from a telephone and the analog signal is converted into a digital signal in a first format. A modem is provided for receiving the digital signal in the first format. A digitizer is also provided for receiving the analog signal from the telephone. The system, in a first mode of operation, couples the digital signal in the first format to the modem, and in a second mode of operation, couples the analog signal from the telephone to the digitizer. The second mode of operation may be, for example, a power failure mode of operation.

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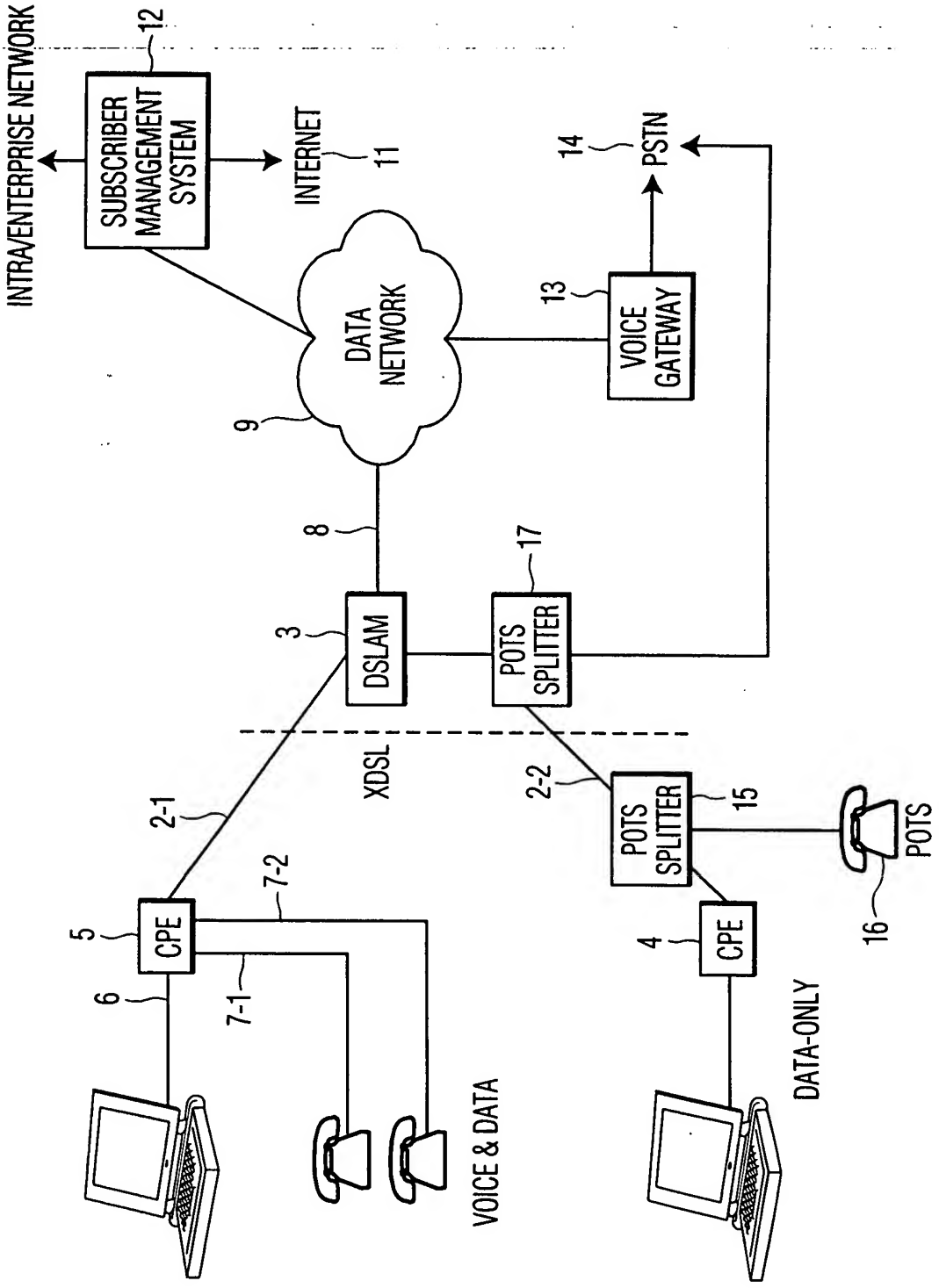
FIG. 1
PRIOR ART



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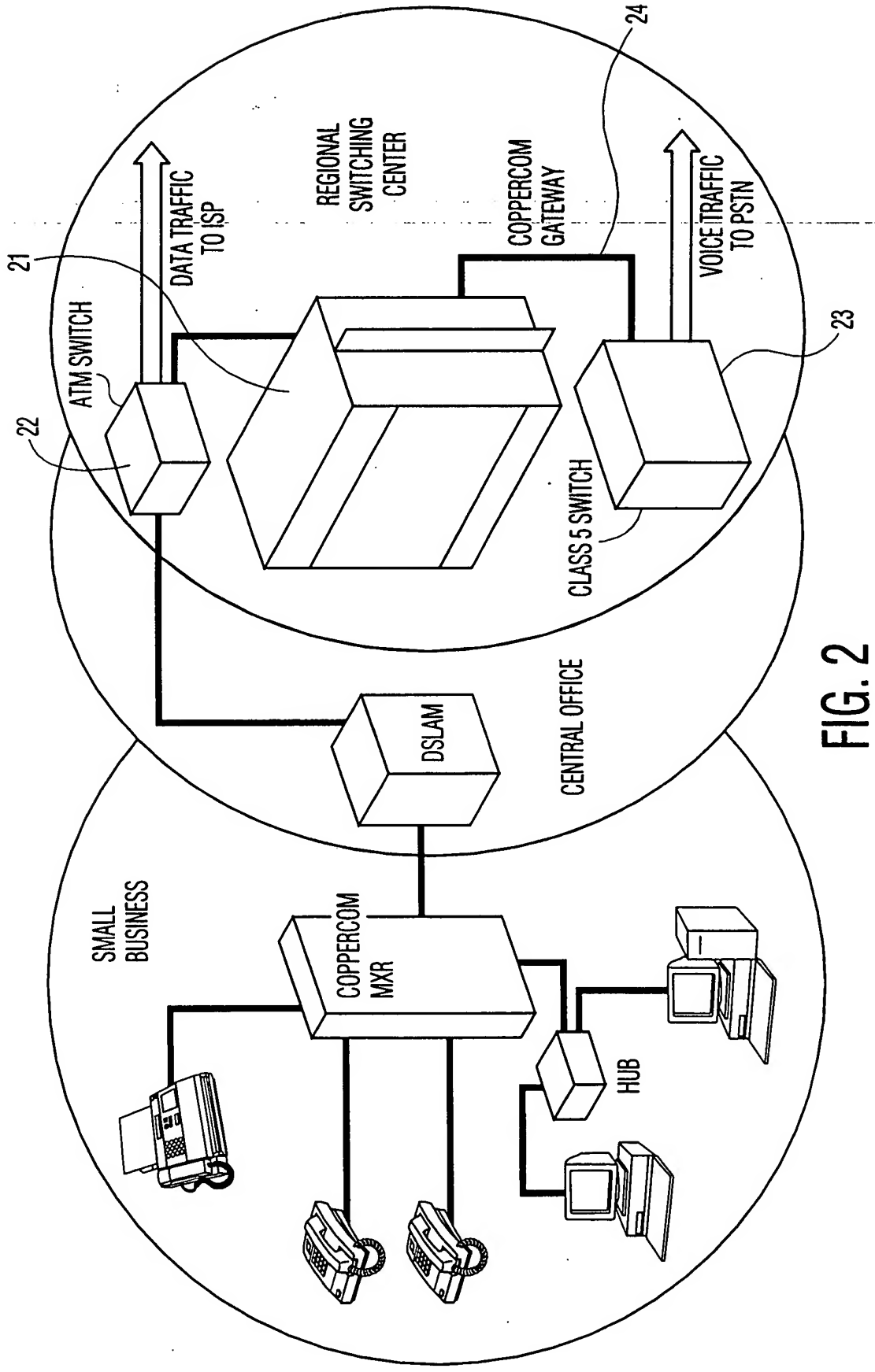

FIG. 2

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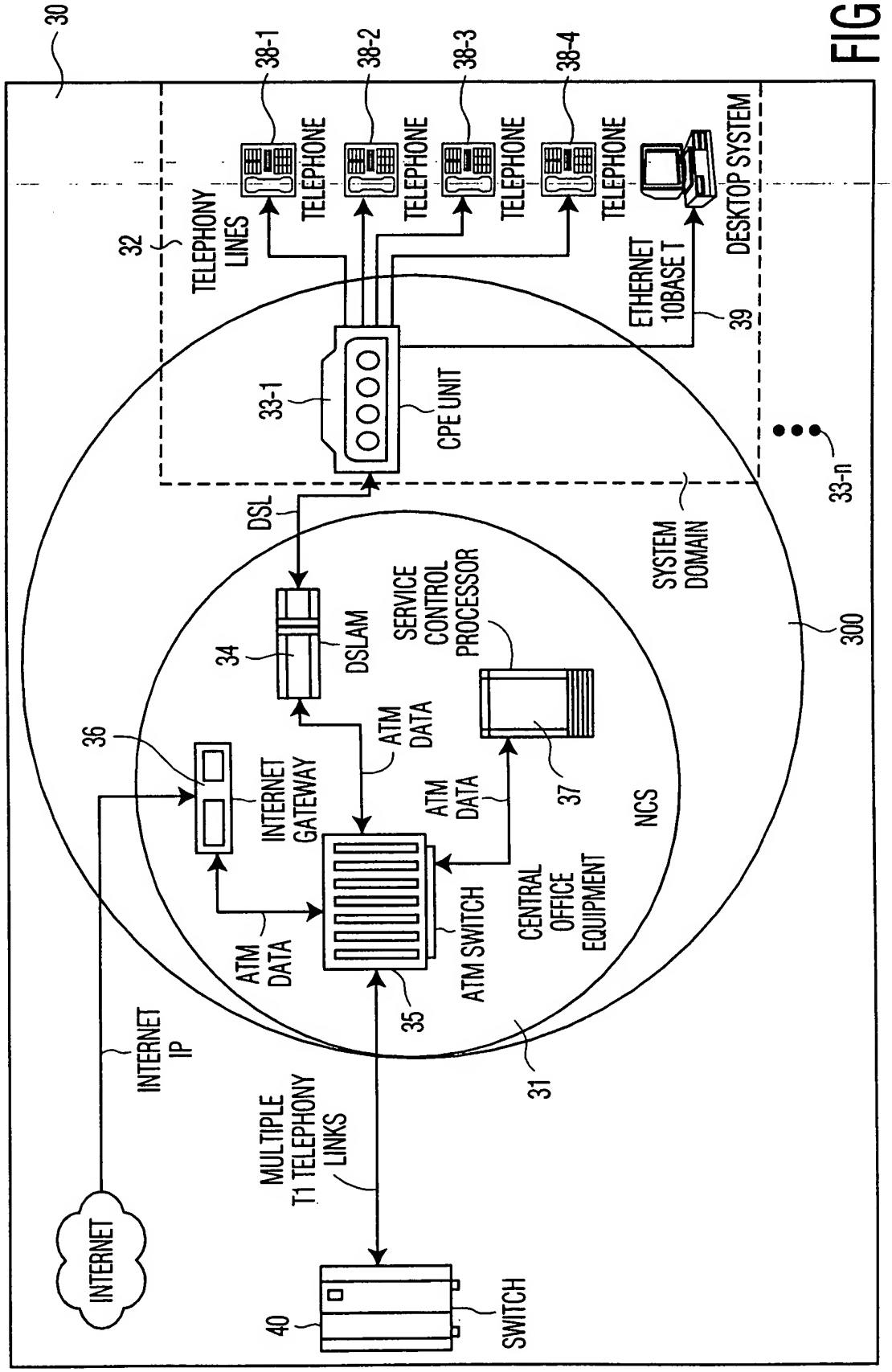
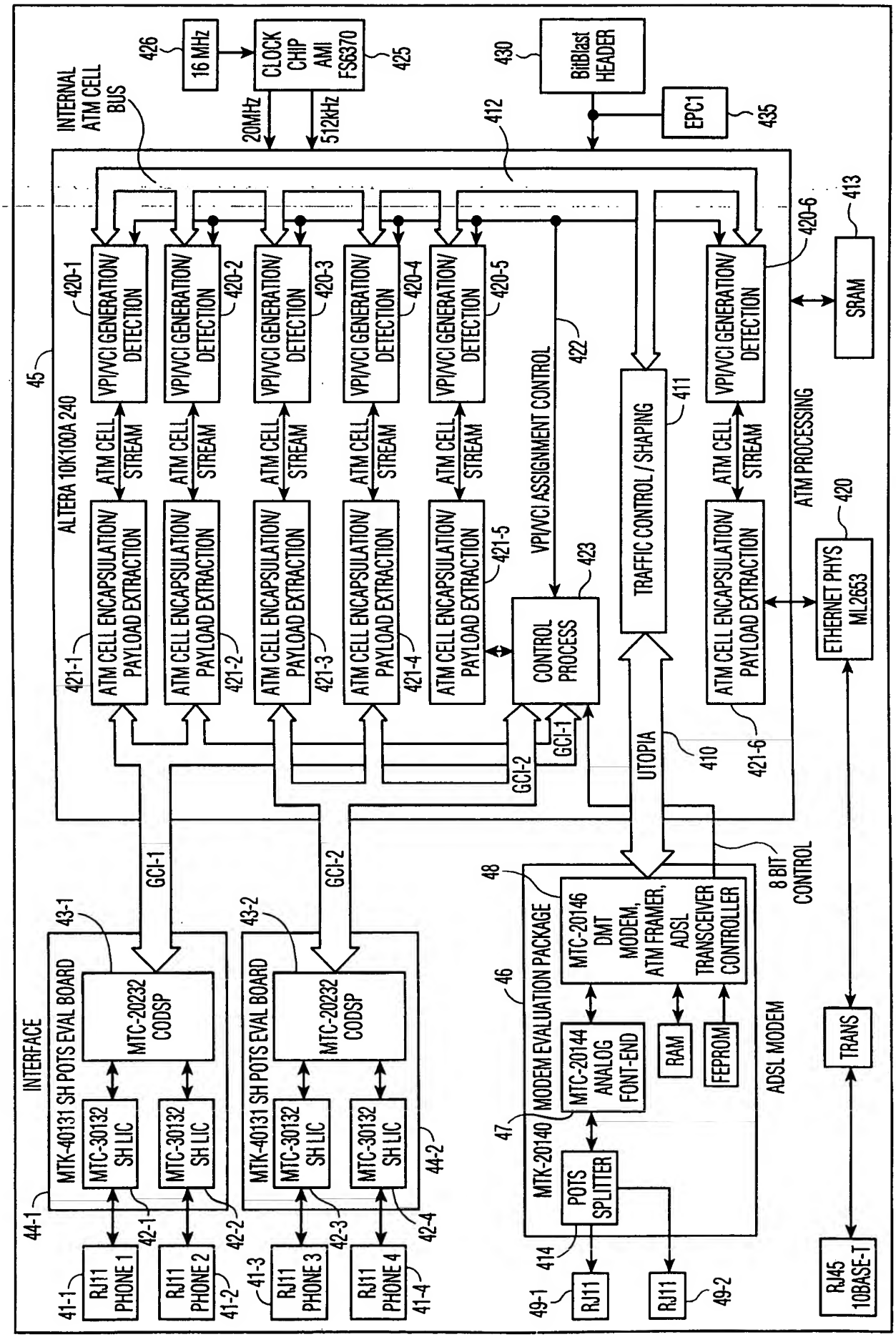


FIG. 3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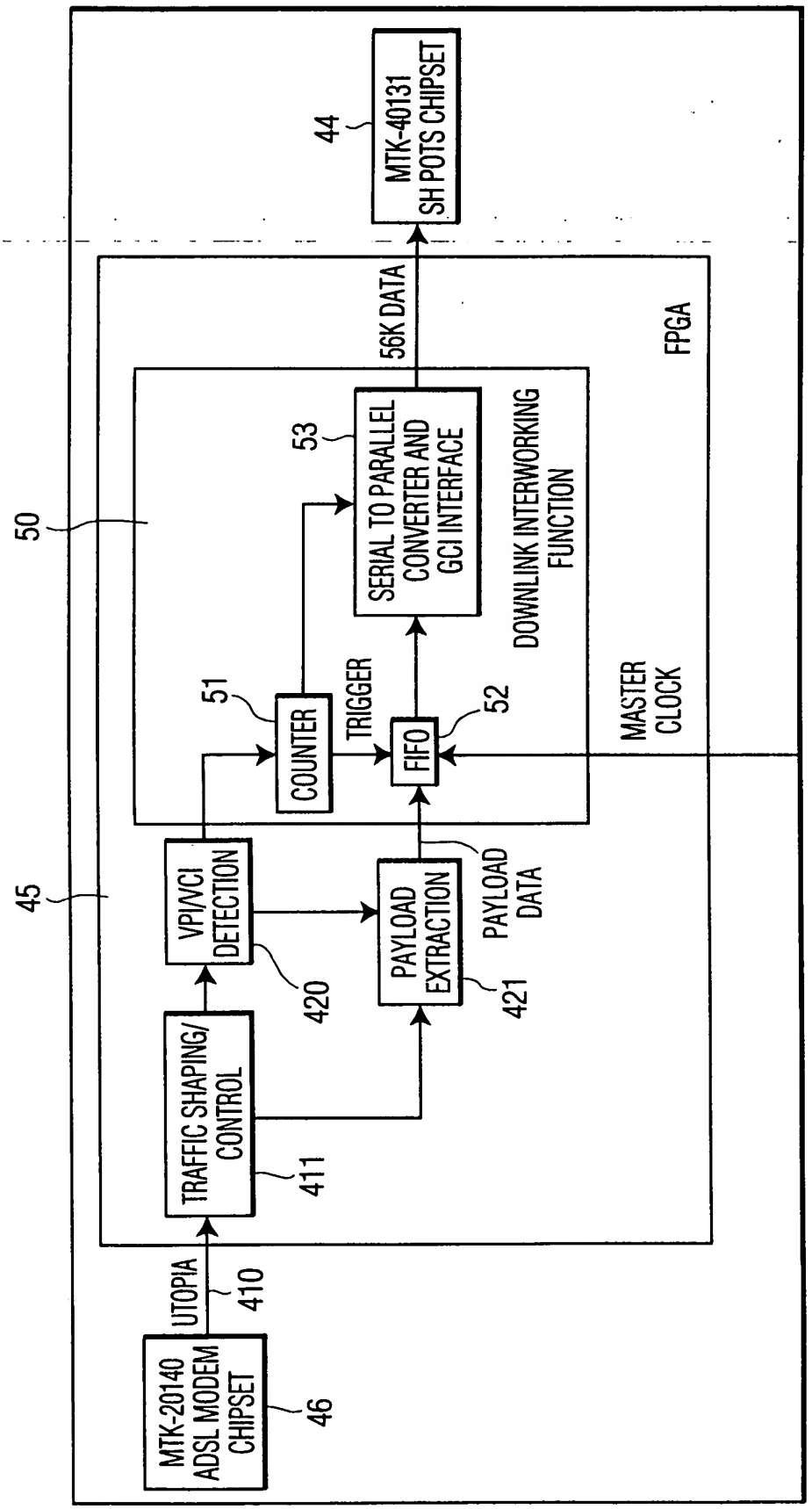
426
16 MHz
CLOCK CHIP AMI FS6370
425
20MHz
512KHz
430
BitBlast HEADER
EPC1
435
412
45
ALTERA 10K100A 240
VPI/VCI GENERATION/ DETECTION
420-1
420-2
420-3
420-4
420-5
420-6
ATM CELL STREAM
ATM CELL ENCAPSULATION/ PAYLOAD EXTRACTION
421-1
421-2
421-3
421-4
421-5
421-6
VPI/VCI ASSIGNMENT CONTROL
422
CONTROL PROCESS
423
TRAFFIC CONTROL / SHAPING
411
ATM PROCESSING
SRAM
413
ETHERNET PHYS ML2653
420
UTOPIA
410
GCI-1
GCI-2
8 BIT CONTROL
INTERFACE
43-1
43-2
MTK-40131 SH POTS EVAL BOARD
MTC-20232 CODSP
MTC-30132 SH LIC
44-1
44-2
41-1
41-2
41-3
41-4
RJ11 PHONE 1
RJ11 PHONE 2
RJ11 PHONE 3
RJ11 PHONE 4
42-1
42-2
42-3
42-4
48
46
MODEM EVALUATION PACKAGE
MTC-20146 DMT MODEM, ATM FRAMER, ADSL TRANSCEIVER CONTROLLER
MTC-20144 ANALOG FONT-END
RAM
FEPROM
47
MTK-20140
POTS SPLITTER
414
ADSL MODEM
TRANS
RJ45 10BASE-T
49-1
49-2
RJ11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UTOPIA
410
TRAFFIC SHAPING/
CONTROL
411
VPI/VCI
DETECTION
420
PAYLOAD
EXTRACTION
421
PAYLOAD
DATA
45
50
COUNTER
51
TRIGGER
FIFO
52
SERIAL TO PARALLEL
CONVERTER AND
GCI INTERFACE
53
DOWNLINK INTERWORKING
FUNCTION
MASTER
CLOCK
56K DATA
FPGA
MTK-40131
SH POTS CHIPSET
44

FIG. 5

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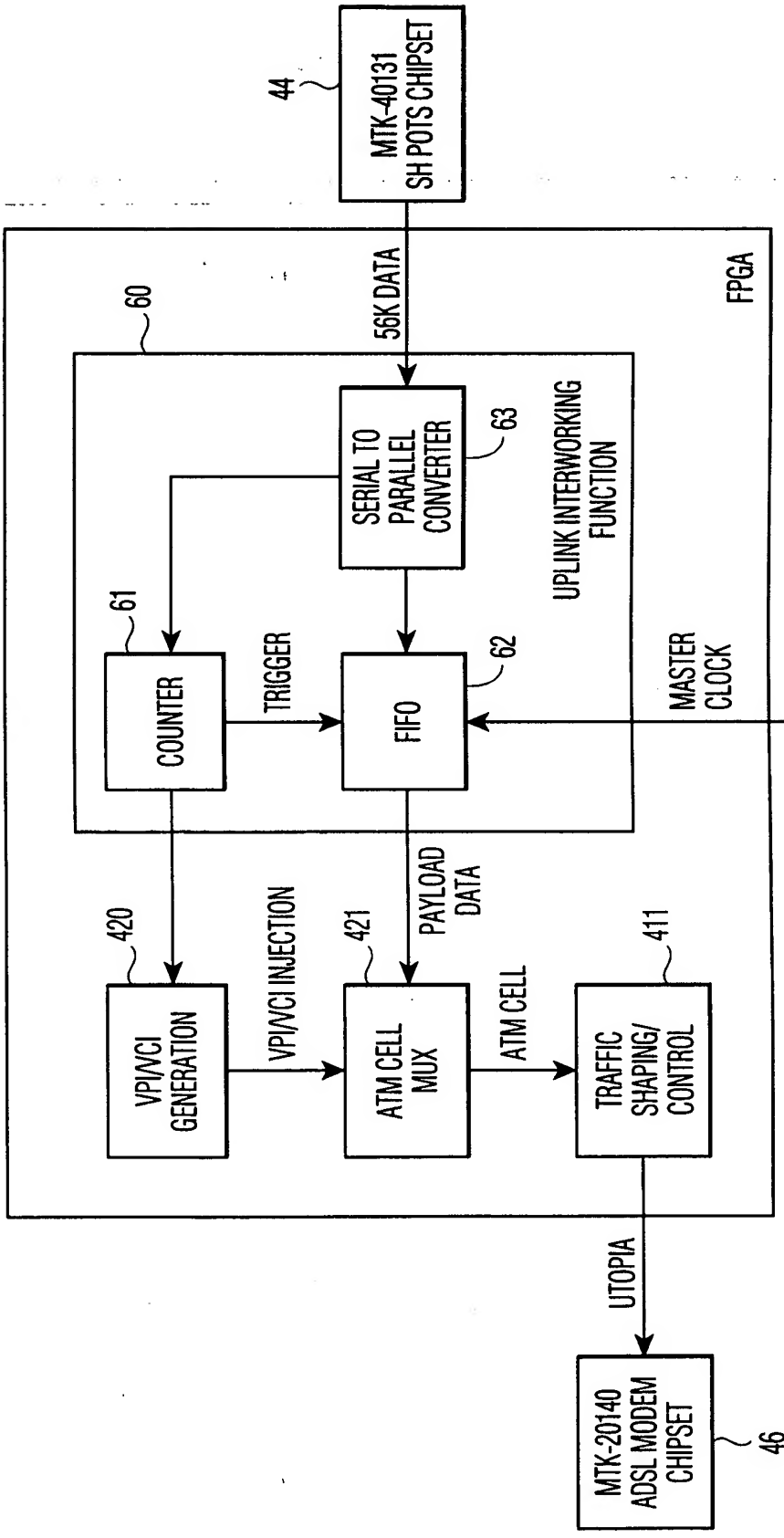

FIG. 6

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FIG. 7

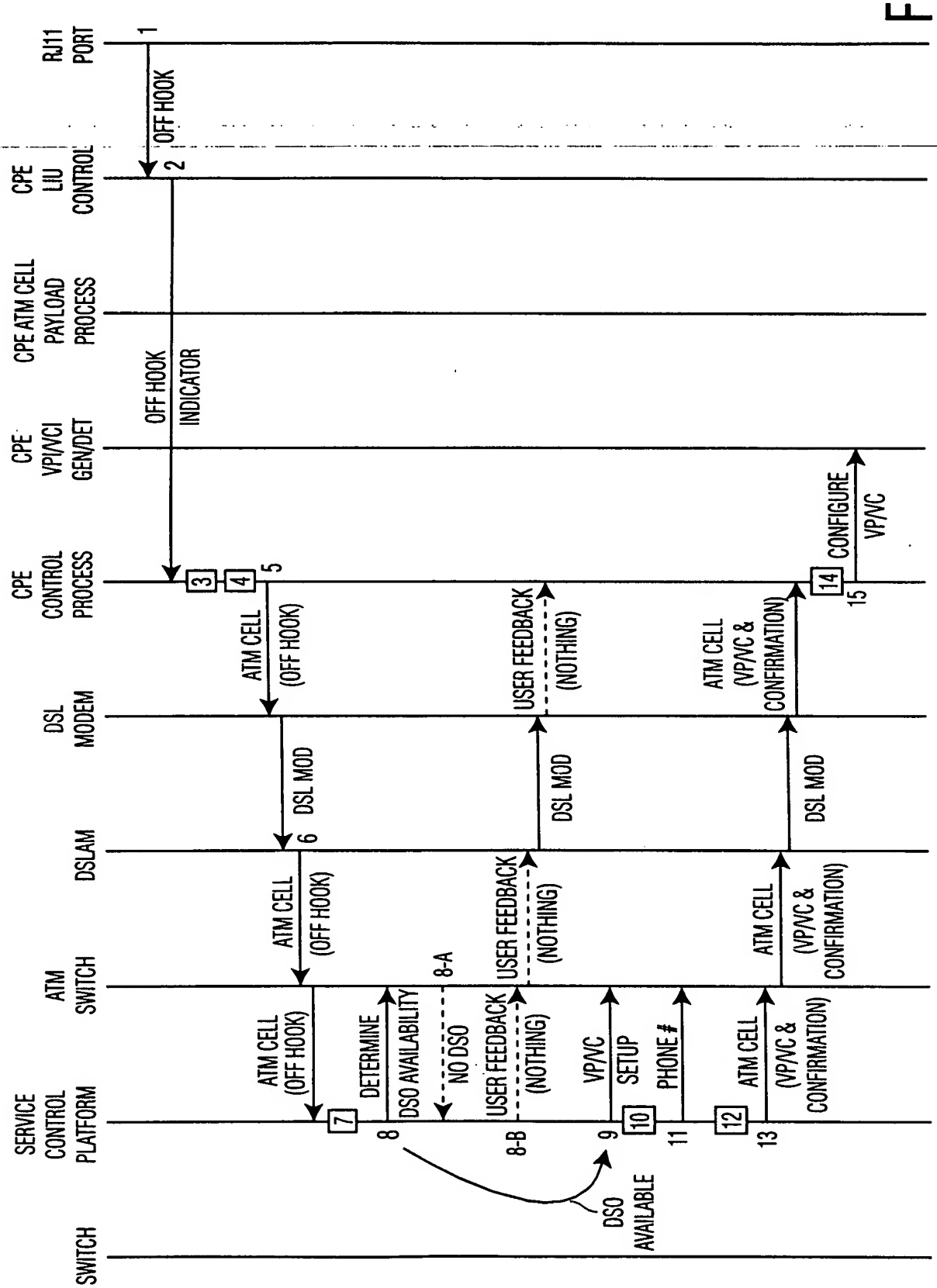

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FIG. 8

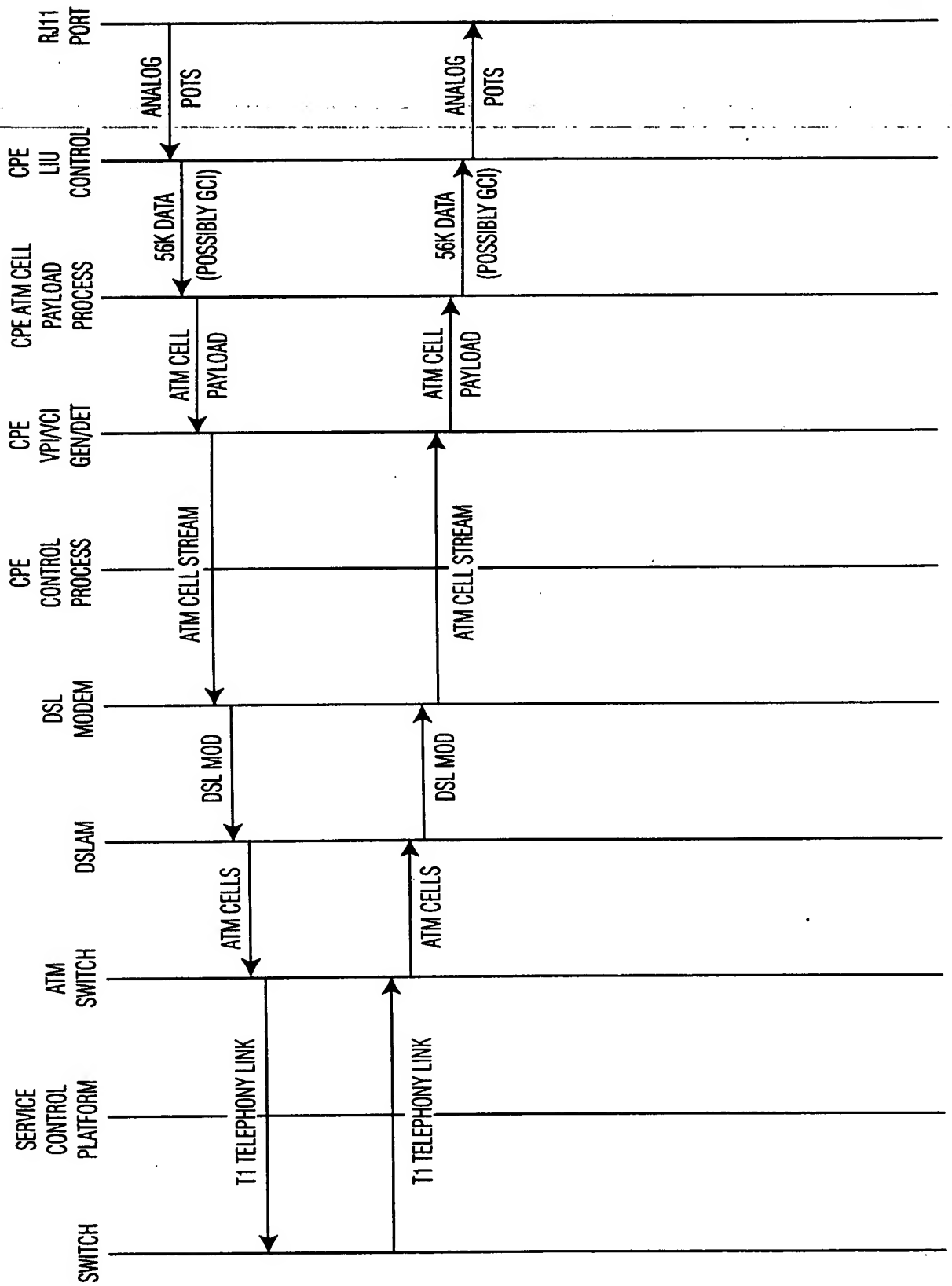

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FIG. 9

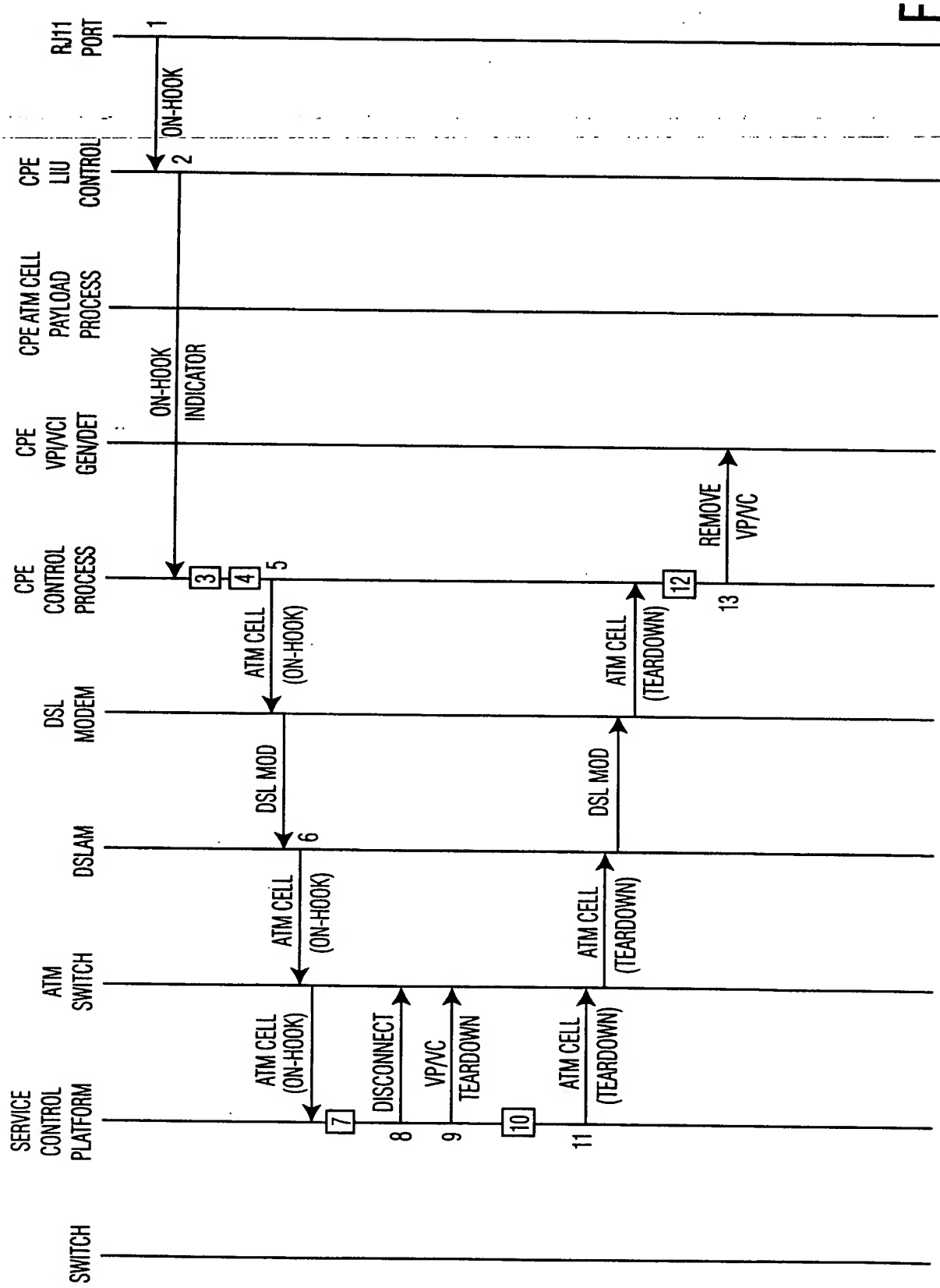

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FIG. 10

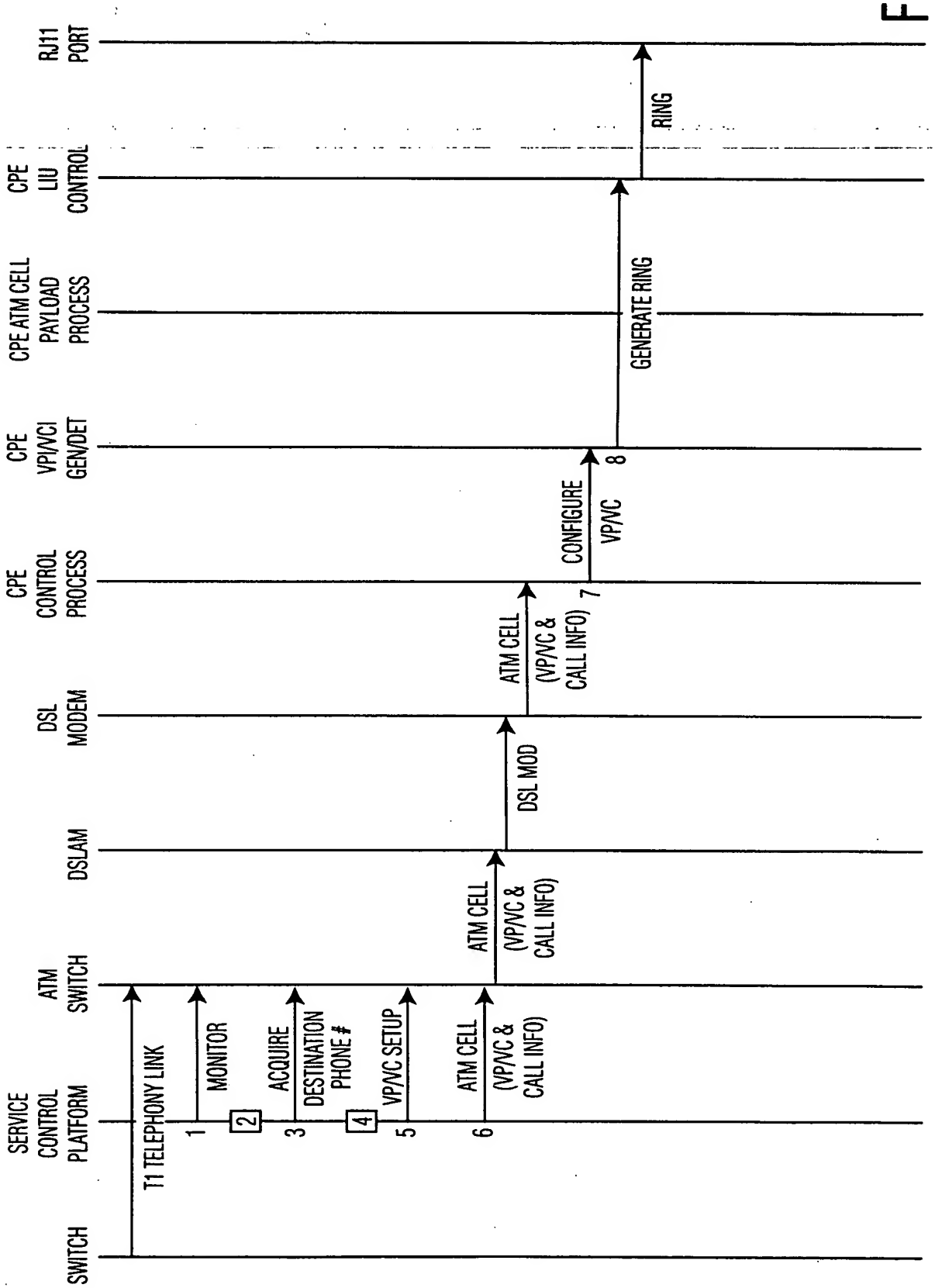

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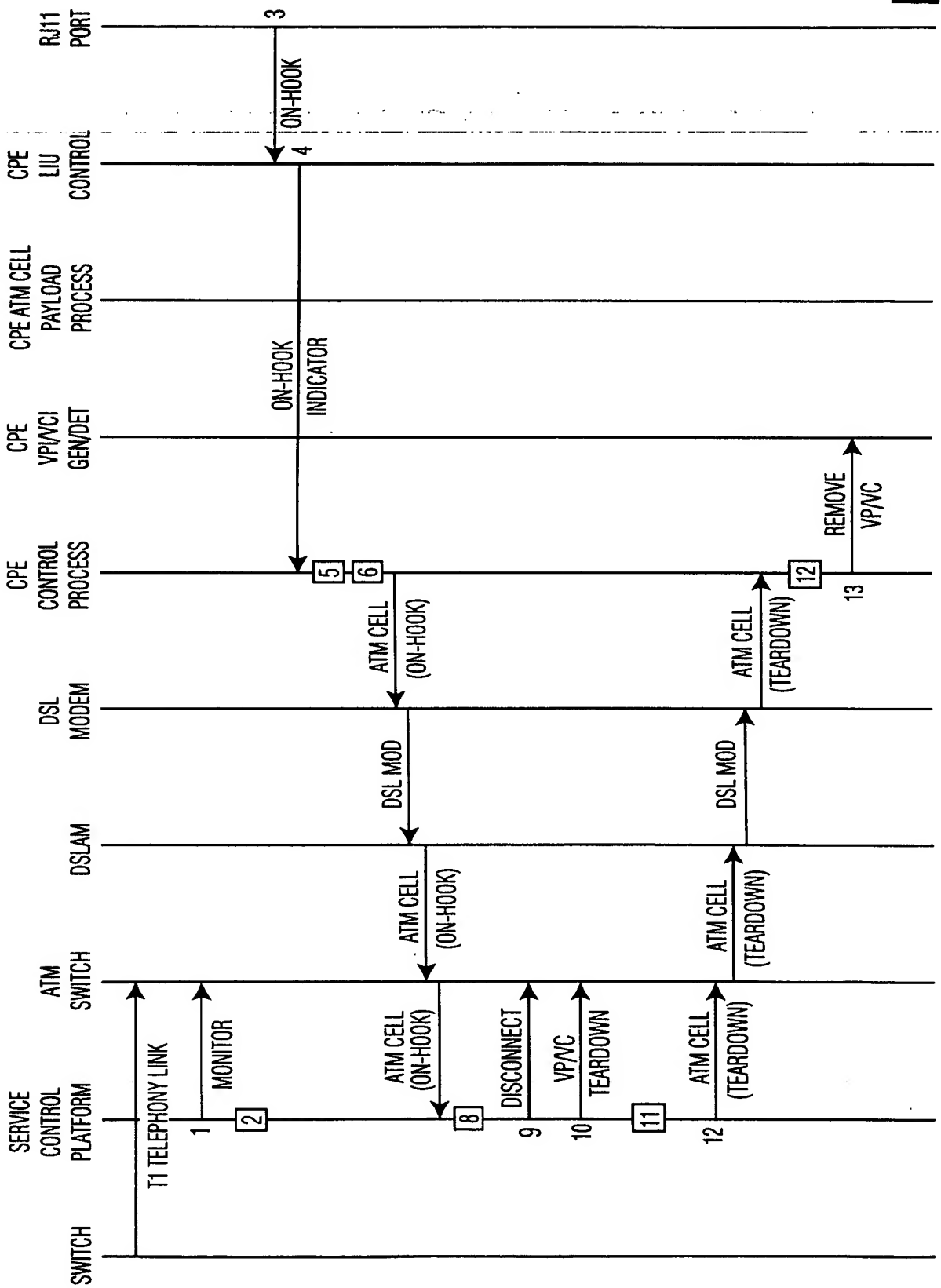
FIG. 11



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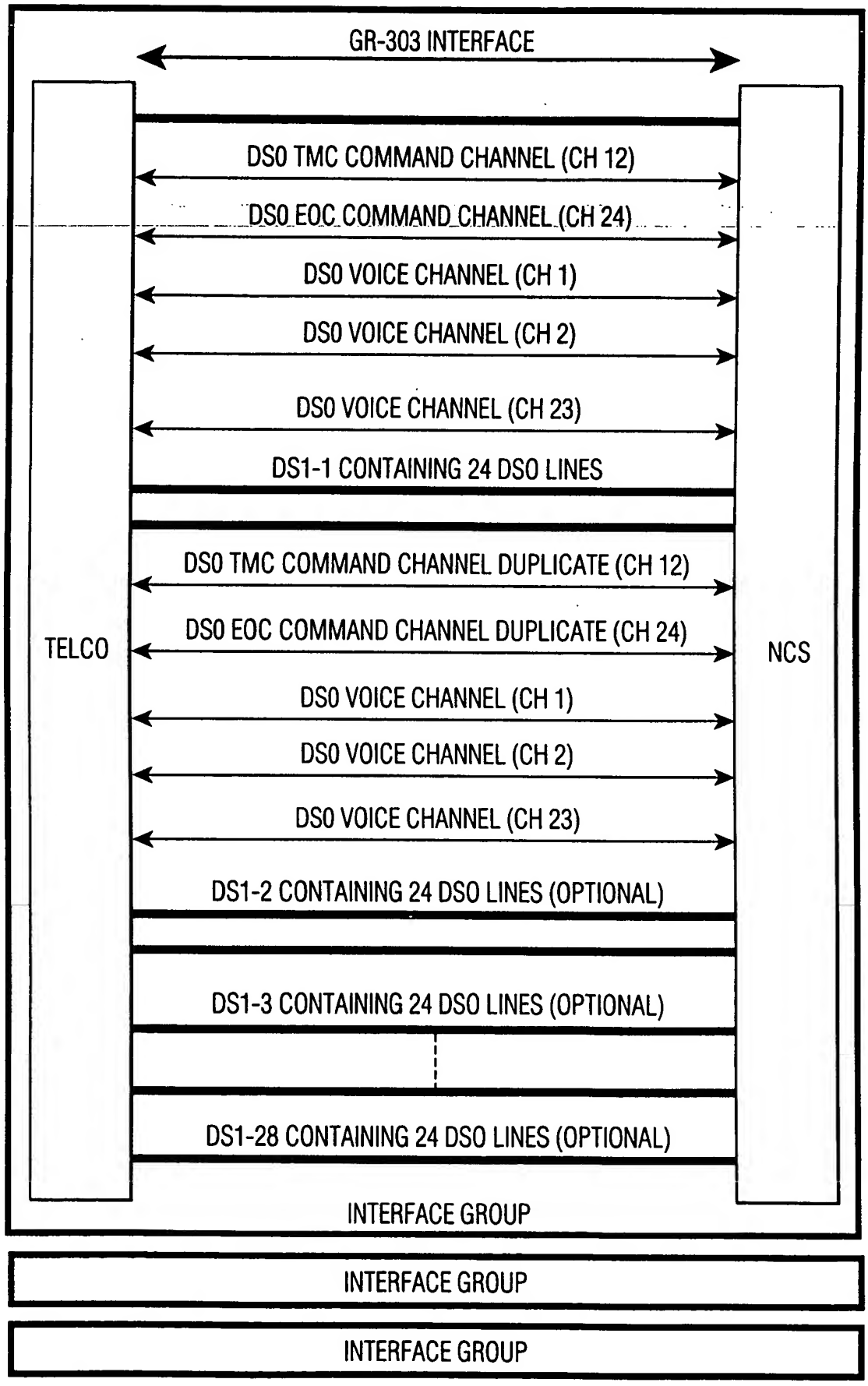

FIG. 12

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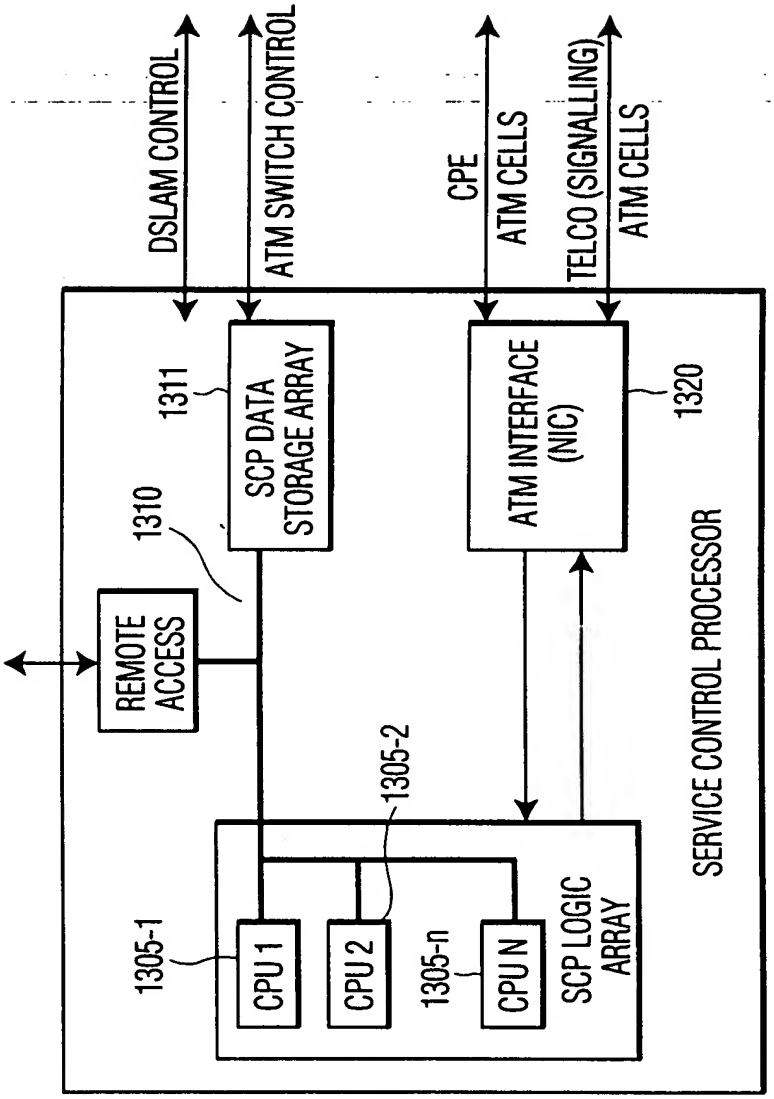

FIG. 13

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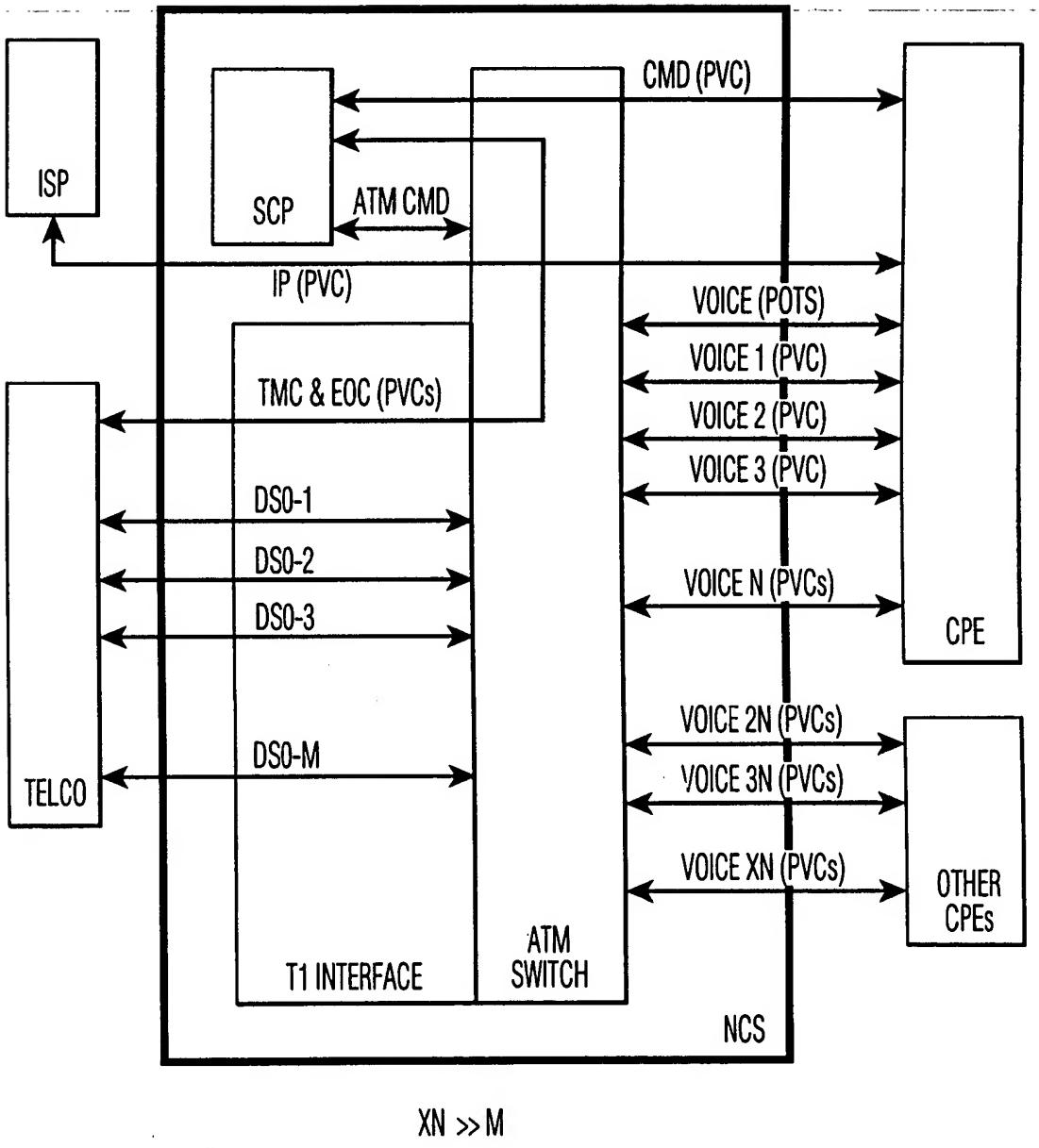

FIG. 14

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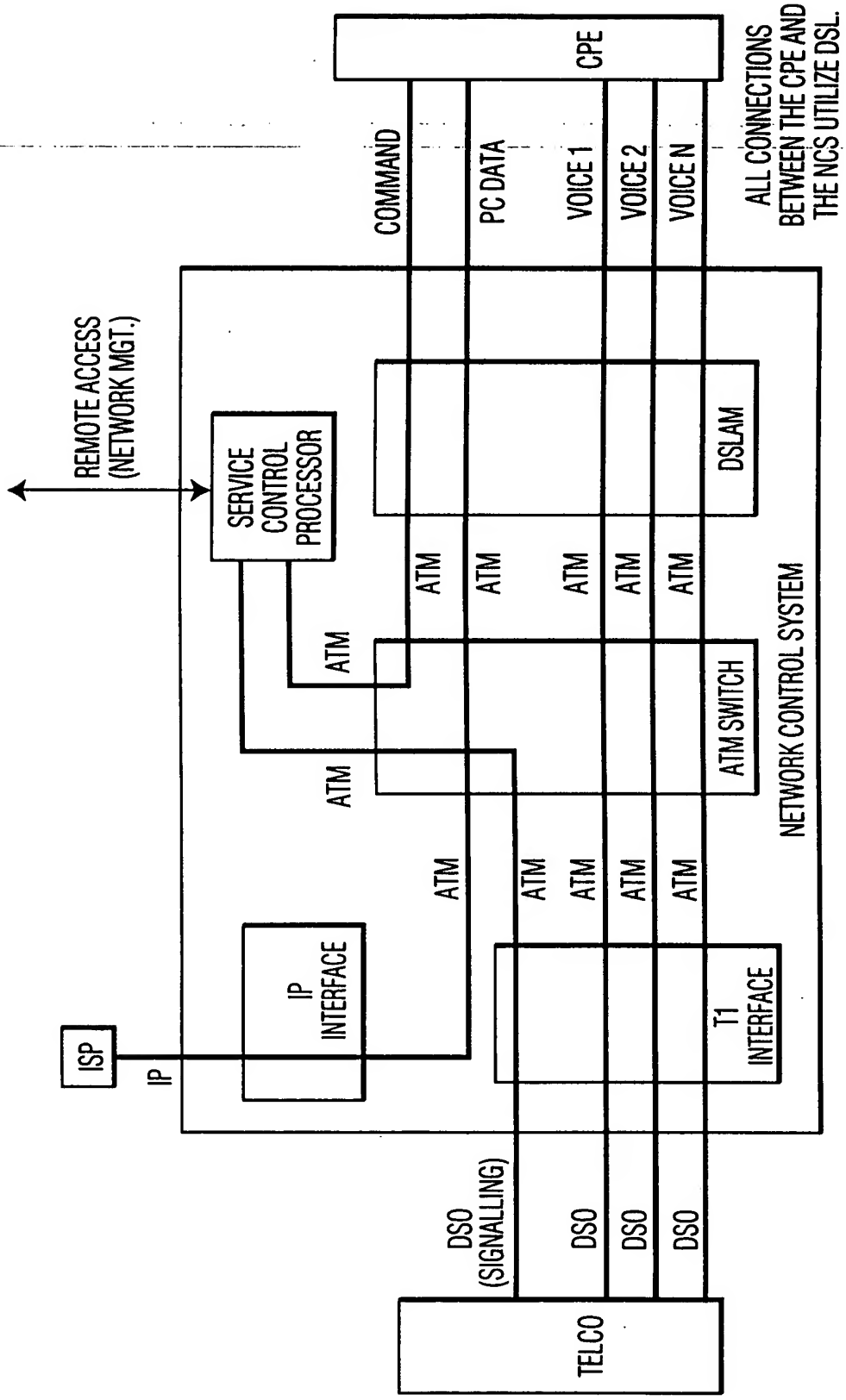

FIG. 15

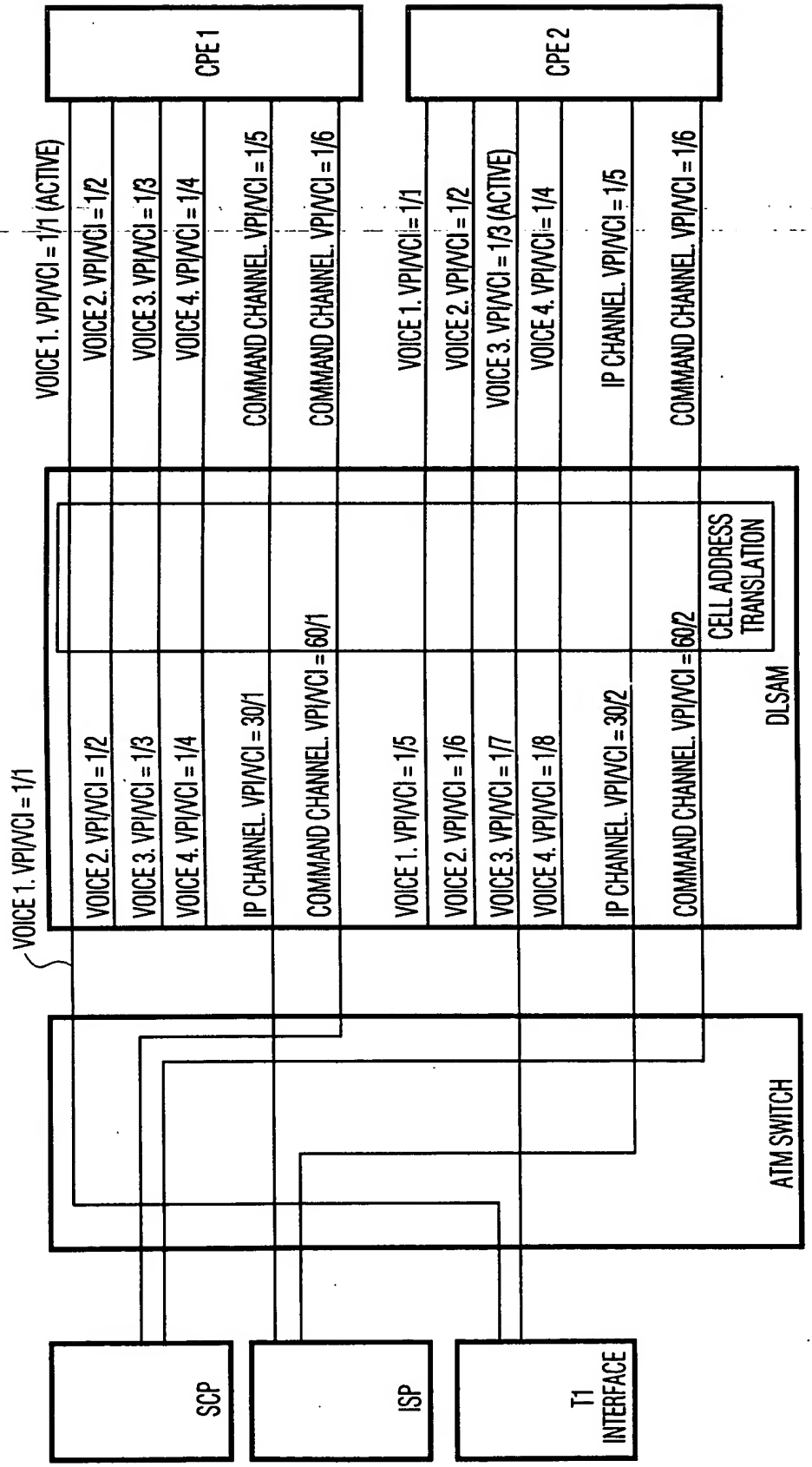
CPE 1
CPE 2
VOICE 1. VPI/VCI = 1/1 (ACTIVE)
VOICE 2. VPI/VCI = 1/2
VOICE 3. VPI/VCI = 1/3
VOICE 4. VPI/VCI = 1/4
COMMAND CHANNEL. VPI/VCI = 1/5
COMMAND CHANNEL. VPI/VCI = 1/6
VOICE 1. VPI/VCI= 1/1
VOICE 2. VPI/VCI = 1/2
VOICE 3. VPI/VCI = 1/3 (ACTIVE)
VOICE 4. VPI/VCI= 1/4
IP CHANNEL. VPI/VCI = 1/5
COMMAND CHANNEL. VPI/VCI = 1/6
VOICE 1. VPI/VCI = 1/1
VOICE 2. VPI/VCI = 1/2
VOICE 3. VPI/VCI = 1/3
VOICE 4. VPI/VCI = 1/4
IP CHANNEL. VPI/VCI = 30/1
COMMAND CHANNEL. VPI/VCI = 60/1
VOICE 1. VPI/VCI = 1/5
VOICE 2. VPI/VCI = 1/6
VOICE 3. VPI/VCI = 1/7
VOICE 4. VPI/VCI = 1/8
IP CHANNEL. VPI/VCI = 30/2
COMMAND CHANNEL. VPI/VCI = 60/2
CELL ADDRESS TRANSLATION
DLSAM
ATM SWITCH
SCP
ISP
T1 INTERFACE

FIG. 16

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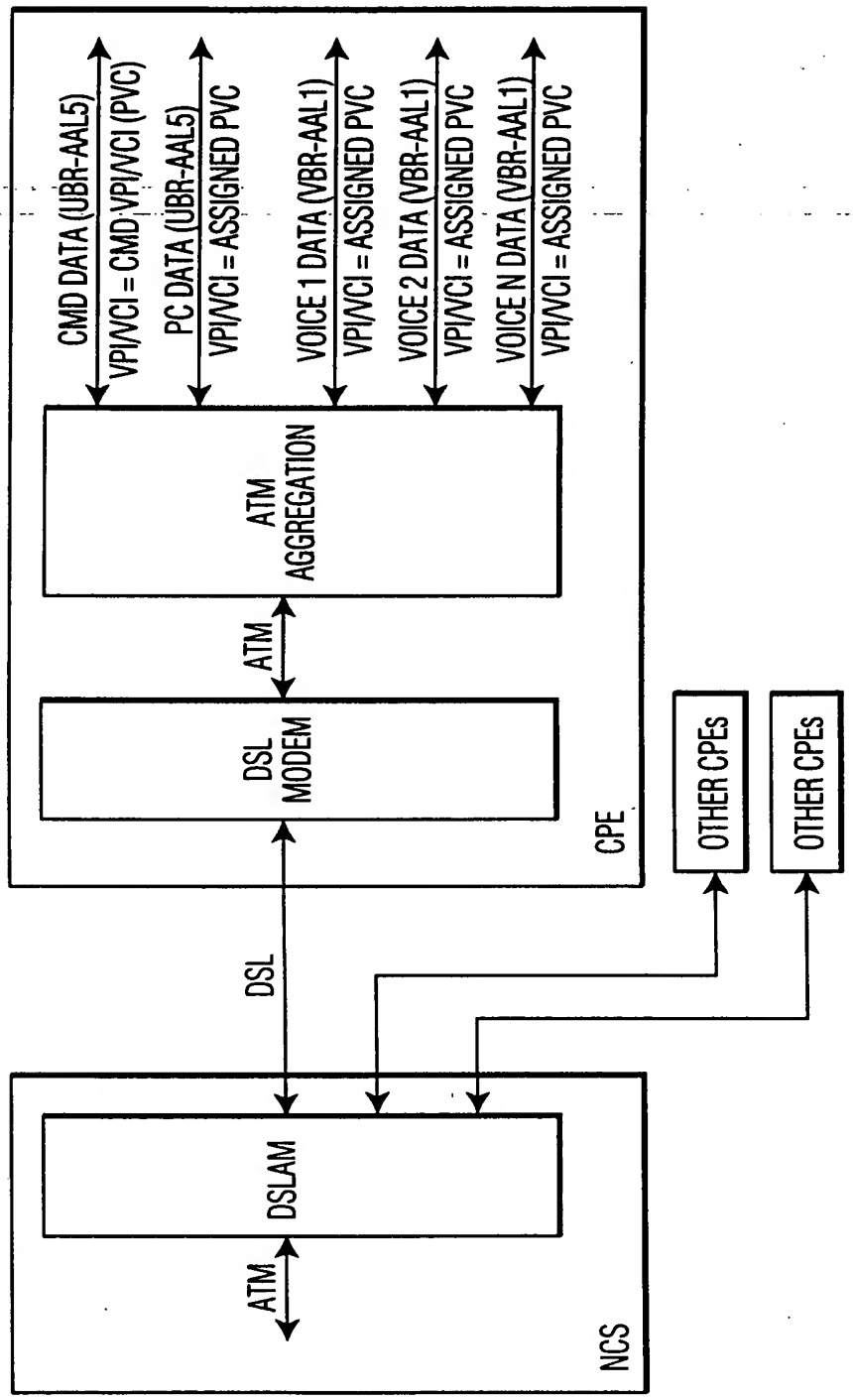

FIG. 17

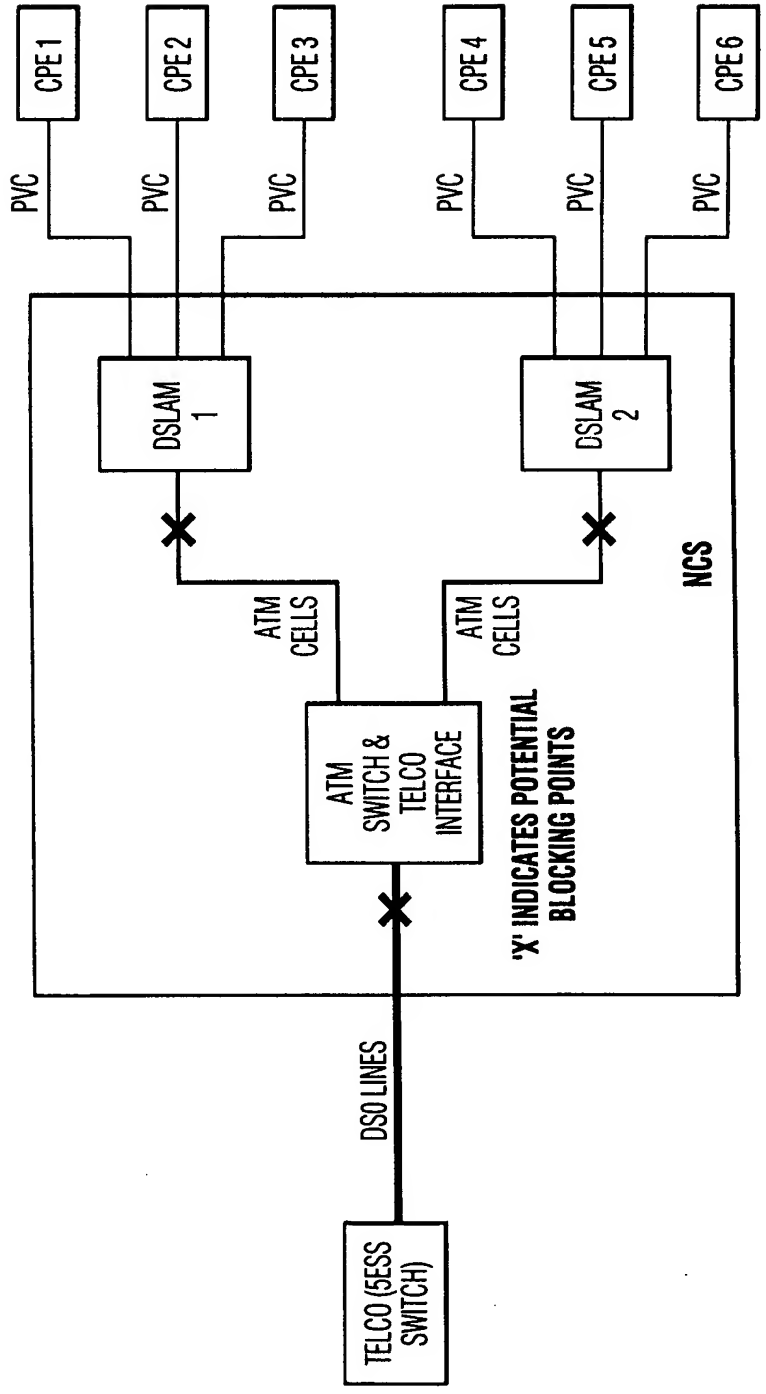
CPE 1
CPE 2
CPE 3
CPE 4
CPE 5
CPE 6
PVC
PVC
PVC
PVC
PVC
PVC
DSLAM 1
DSLAM 2
ATM CELLS
ATM CELLS
NCS
ATM SWITCH & TELCO INTERFACE
'X' INDICATES POTENTIAL BLOCKING POINTS
DS0 LINES
TELCO (5ESS SWITCH)

FIG. 18

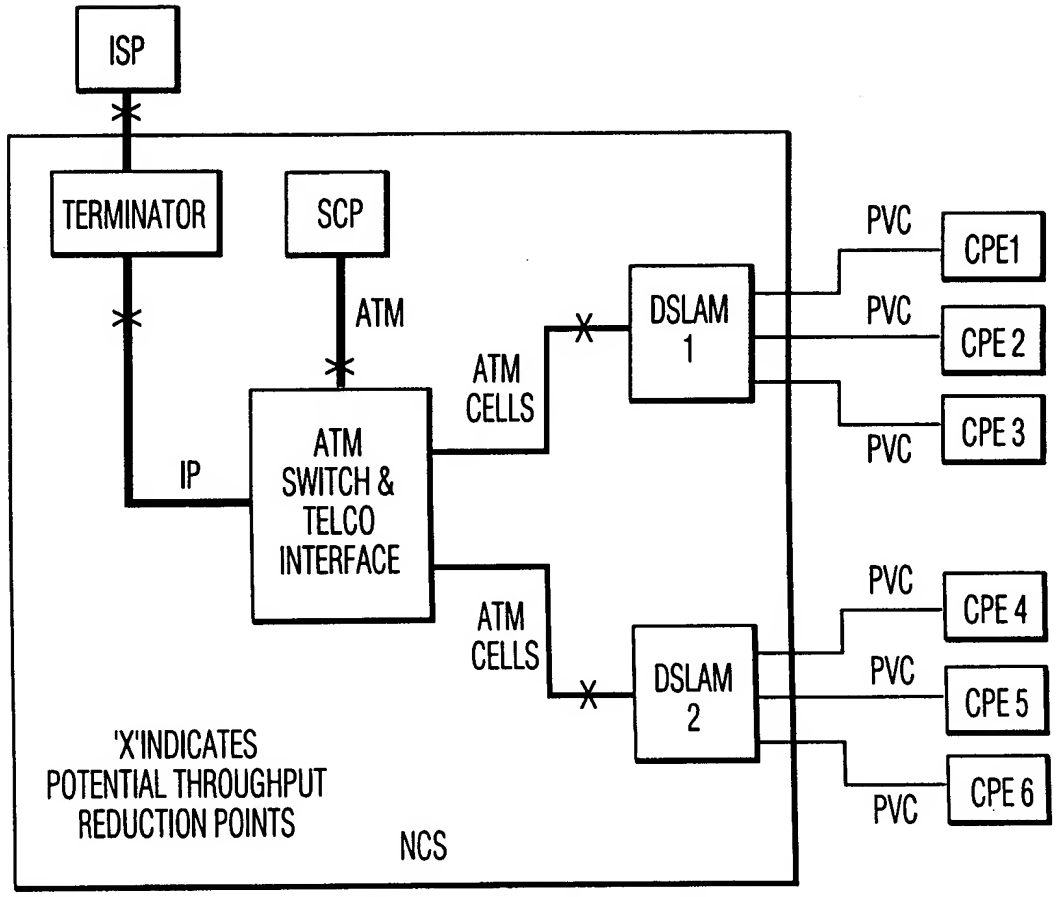
ISP
TERMINATOR
SCP
ATM
IP
ATM SWITCH & TELCO INTERFACE
ATM CELLS
DSLAM 1
ATM CELLS
DSLAM 2
PVC
CPE1
PVC
CPE 2
PVC
CPE 3
PVC
CPE 4
PVC
CPE 5
PVC
CPE 6
'X'INDICATES POTENTIAL THROUGHPUT REDUCTION POINTS
NCS

FIG. 19

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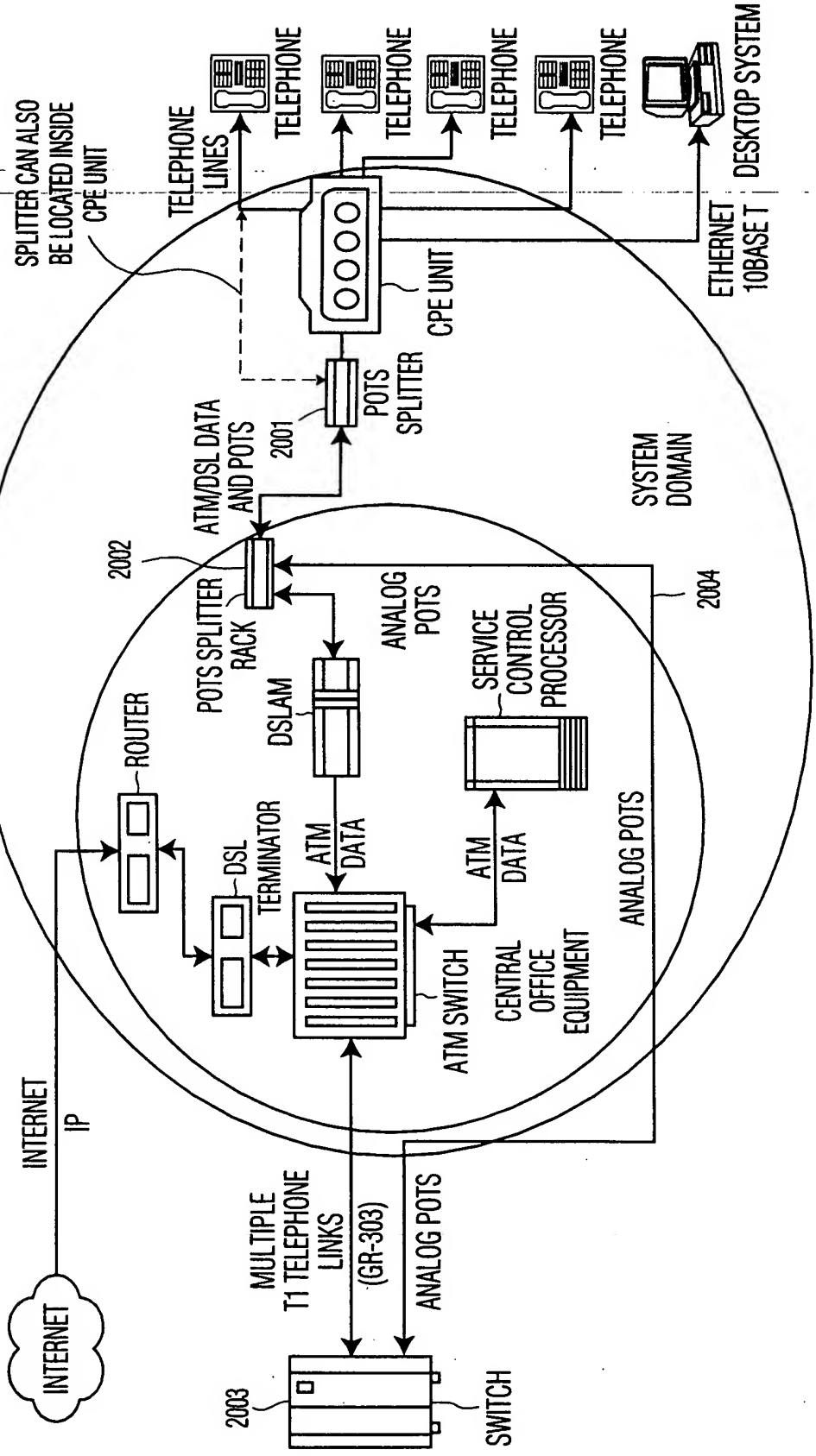

FIG. 20

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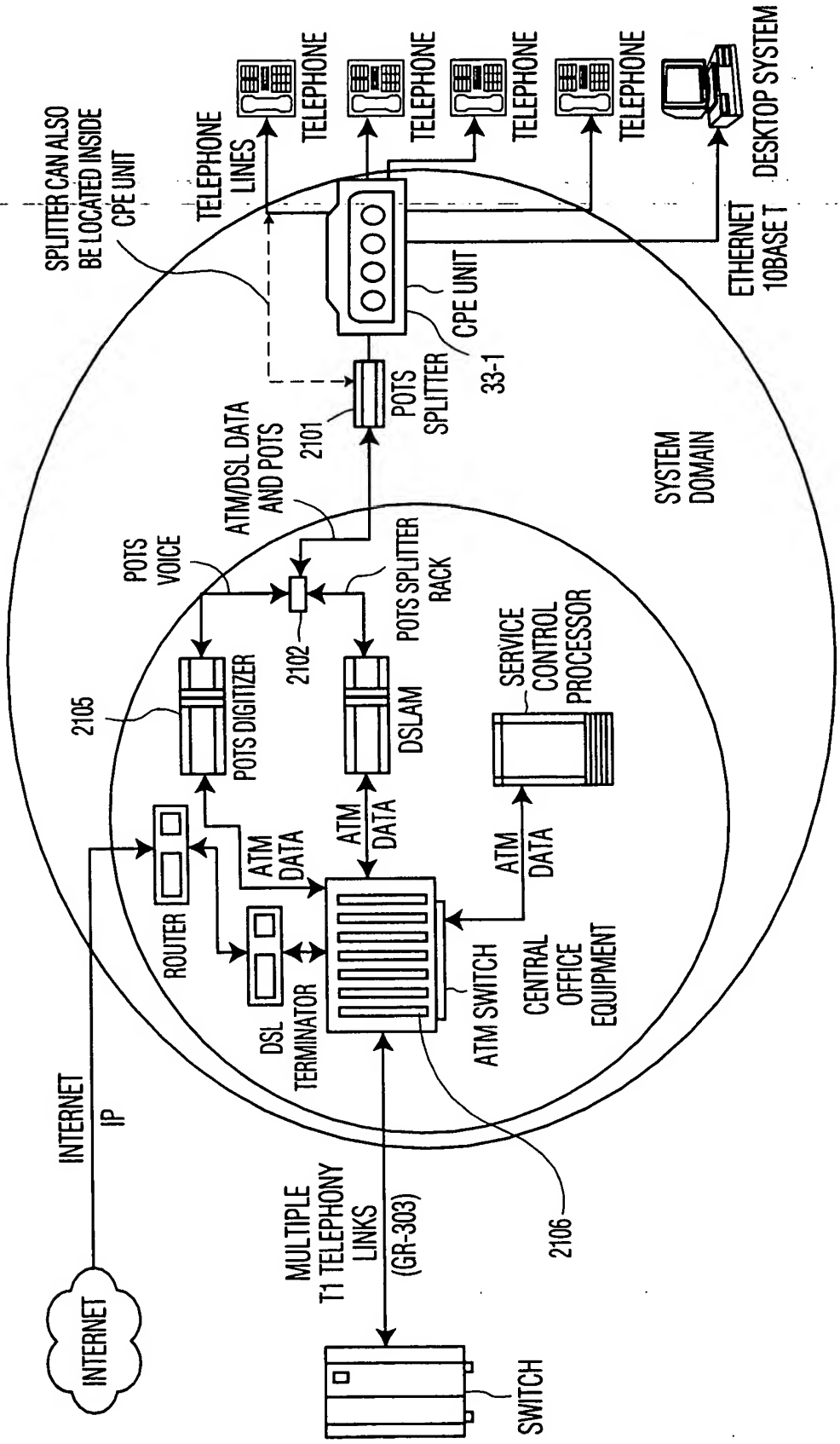

FIG. 21

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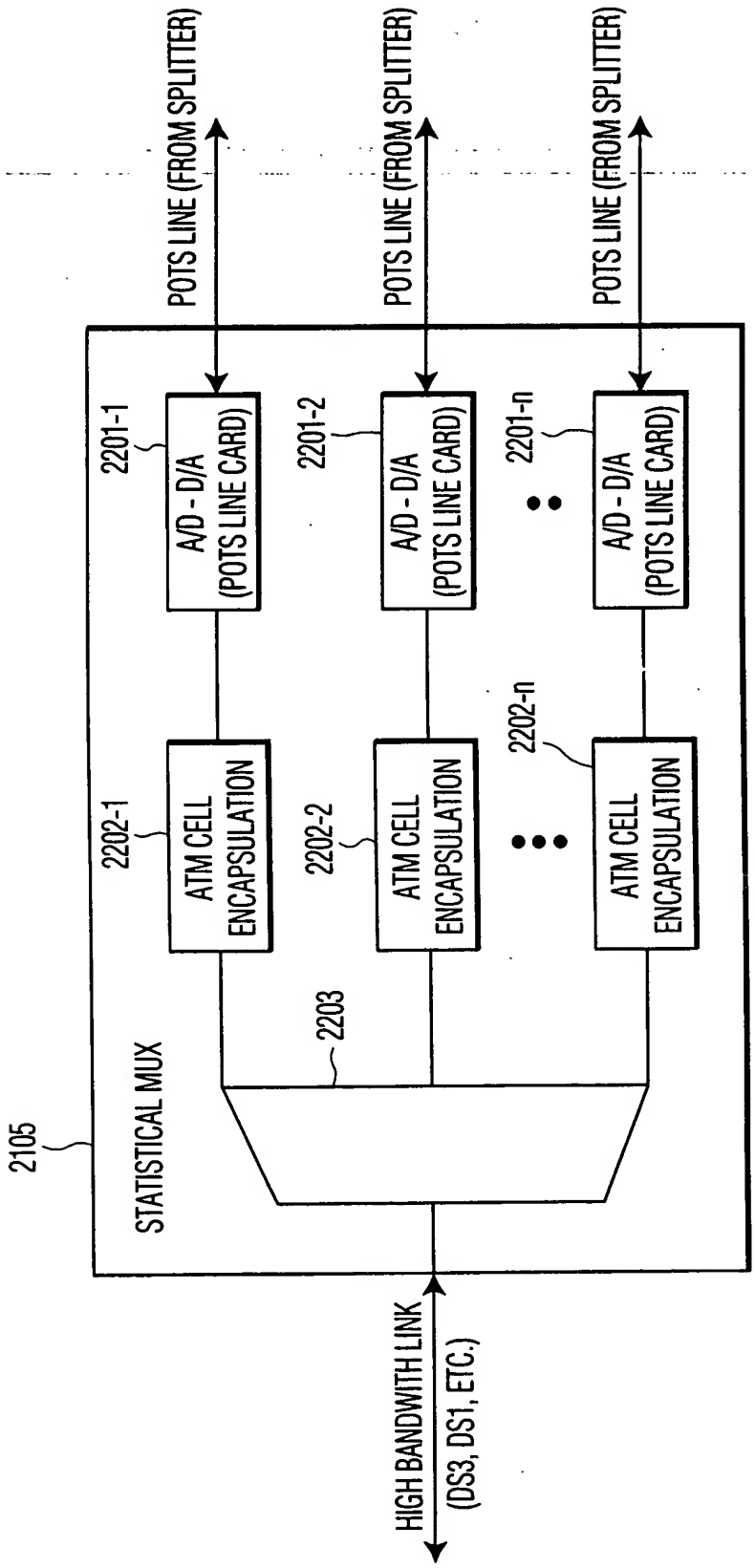

FIG. 22